Preface

Rapid advances and wide availability have caused knowledge management to permeate the lives of people from all walks of life. The development of the distributed knowledge technologies has extended the reach of computer intelligence to almost everyone.

In our book, intelligence integration can be understood in two aspects. The first is referred to as methods for integration of human intelligence useful for management and social sciences. The second aspect is related to integration methods for intelligent computer systems such as agent systems, Web-based systems, ad hoc systems and so forth. The subject of this edited book is focused on the second aspect. It covers a broad range of intelligence integration approaches in distributed knowledge systems, from Web-based systems through multi-agent and grid systems, and ontology management to fuzzy approaches. It presents cutting edge research in knowledge management in the first decade of the 21st century. The new directions include integration of computational intelligence, distributed computing and data mining.

In order to achieve the goals of better knowledge integration in the field of distributed environment that collect modern approaches from artificial intelligence, computer communication, and information systems, several issues need to be addressed. These issues can be summarized by new computing ideas for, among other things:

- Advanced data analysis, including Web mining and knowledge discovery;
- Coordination, collaboration, cooperation and other related dynamic mechanisms;
- Data, code, signal and behavior propagation strategy;
- Data migration and metadata evolution;
- Decision analysis, optimization and control;
- E-learning algorithms and architectures;
- Error detection and communication methods;
- Robust grid computing and multi-agent systems;
- Information processing using intelligent and hybrid systems;
- Integrity maintenance in open systems; and
- Representation, elicitation and processing of uncertain, imprecise and incomplete knowledge.

The research reported in this book is focused first and foremost on the above topics. The approach followed to explain these topics is intentionally broad and exploratory.

This volume is focused on topics worthy of interest due to their significant advances. From the submissions, the editors have selected 19 of the most interesting chapters for publication. These chapters have been divided into three parts: *Advanced Methods for Integration*, *Integration Aspects for Agent Systems*, and *Fuzzy-based and other Methods for Integration*.

The first section, *Advanced Methods for Integration,* consists of six chapters.

It starts with the chapter of J.L. Kulikowski, which gives an outlook on the possibility of ontological models extension serving to effective and universal domain knowledge representation in computer systems supporting decision making in various application areas. It is given a definition of ontology and of ontological models as well as their formal representation by taxonomic trees, bi-partite graphs, multigraphs, relations, super-relations and hyper-relations. The definitions of the corresponding mathematical notions are also given. Then, the concept of ontologies representing incomplete or uncertain domain knowledge is presented. This concept is illustrated by an example of decision making in medicine.

The second chapter is by A. Bǎdicǎ et al., and discusses data extraction from Web pages. The Web is designed as a major information provider for the human consumer. However, information published on the Web is difficult to understand and reuse by a machine. In this chapter, the authors show how well established intelligent techniques based on logic programming and inductive learning combined with more recent XML technologies might help to improve the efficiency of the task of data extraction from Web pages. Their work can be seen as a necessary step of the more general problem of Web data management and integration.

In the third chapter, A. Jacobsson and P. Davidsson introduce a formal model of virtual enterprises as well as an analysis of their creation and operation. It is argued that virtual enterprises offer a promising approach to promote both innovations and collaboration between companies. A framework of integrated ICT-tools, called Plug and Play Business, which support innovators in turning their ideas into businesses by dynamically forming virtual enterprises, is also formally specified. Furthermore, issues regarding the implementation of this framework are discussed and some useful technologies are identified.

The fourth chapter, by D. Orski, concerns a class of systems composed of operations performed with the use of resources allocated to them. In such operation systems, each operation is characterized by its execution time depending on the amount of a resource allocated to the operation. The decision problem consists in distributing a limited amount of a resource among operations in an optimal way, that is, in finding an optimal resource allocation. In the knowledge-based approach considered in this chapter, the execution time of each operation is described in a nondeterministic way, by an inequality containing an unknown parameter, and all the unknown parameters are assumed to be values of uncertain variables characterized by experts.

In the fifth chapter, C. Fencott undertakes a methodological study of virtual environments, a specific subset of interactive systems. The underlying model is characterized as an integration of interaction machines and semiotics with the intention to make the design tension work to the designer's benefit rather than trying to eliminate it. The language is then developed as a juxtaposition of UML and the integration of a range of semiotics-based theories. This leads to a discussion of a process model and the activities that comprise it. The intention throughout is not to build a particular design method, but to investigate the methodological concerns and constraints such a method should address.

In the last chapter of the first section, S. Sanchez-Alonso and D. Frosch-Wilke discuss the similarities between the life cycle of knowledge management and the processes in which competencies are identified and assessed. This chapter also presents the framework's integration into the knowledge life cycle of the knowledge management consortium international in the form of ontological definitions. It includes a brief discussion on some current definitions of the term competency and details the most interesting efforts in the standardization of competency definitions. At the end, it provides a preliminary mapping of competency-related concepts to terms in upper ontologies.

The second section of this book refers to *Integration Aspects for Agent Systems* and consists of seven chapters.

The first chapter, by M. Oliveira and M. Purvis is about some interesting aspects of coordinating and integrating the autonomy in agent societies. In such environments, agents can be embedded in diverse contexts and interact with agents of various types and behaviors. In this chapter, Oliveira and Purvis explore the necessity of dealing with openness in multi-agent systems and its relation with the agent's autonomy. They stress the importance of building coordination mechanisms capable of managing complex agent societies composed by autonomous agents and introduce their institutional environment approach, which includes the use of commitments and normative spaces. It is based on a metaphor in which agents may join an open system at any time, but they must obey regulations in order to maintain a suitable reputation, that reflects its degree of cooperation with other agents in the group, and make them a more desired partner for others. Colored Petri Nets are used to formalize a workflow in the institutional environment defining a normative space that guides the agents during interactions in the conversation space.

Next, in the following chapter, K. Kolomvatsos and S. Hadjiefthymiades present techniques and challenges for trusting agents in multi-agent environments. In such systems, there must be a way for an agent to make sure that it can trust another entity, which is a potential partner. Without trust, agents cannot cooperate effectively and without cooperation they cannot fulfill their goals. Many times, trust is based on reputation. They discuss main issues concerning reputation and trust in MAS. They present research efforts and give formalizations useful for understanding the two concepts.

The third chapter, by M. Nowostawski, presents some novel concepts of autonomy management in distributed computation and multi-agent systems. He re-introduces two concepts: relative autonomy and absolute autonomy. He argues that even though the concept of absolute autonomy does not make sense in computational settings, it is useful if treated as an assumed property of computational units. For example, the concept of autonomous agents facilitates more flexible and robust architectures. He adopts and discusses a new formalism based on results from the study of massively parallel multi-agent systems in the context of evolvable virtual machines. He also presents the architecture for building such architectures based on his multi-agent system KEA, where he uses extended notion of dynamic and flexibly linking. This provides a useful notion and the necessary means to establish autonomy in open distributed systems.

In the fourth chapter, M. Purvis et al., give an analysis of agent-based library management system using RFID technology. One of the major issues in large libraries is to track misplaced items. By moving from conventional technologies such as barcode-based systems to RFID-based systems and using software agents that continuously monitor and track the items in the library, they believe an effective library system can be designed. Due to constant monitoring, the up-to-date location information of the library items can be easily obtained.

The authors of the fifth chapter, S. Savarimuthu et al., present several original mechanisms to restrict exploitation and improve societal performance in multi-agent environments. Societies are made of different kinds of agents, some cooperative and some uncooperative. Uncooperative agents tend to reduce the overall performance of the society, due to exploitation practices. In the real world, it is not possible to decimate all the uncooperative agents; thus, the objective of this research is to design and implement mechanisms that will improve the overall benefit of the society without excluding uncooperative agents. The mechanisms that they have designed include referrals and resource restrictions. A referral scheme is used to identify and distinguish noncooperators and cooperators. Resource restriction mechanisms are used to restrict noncooperators from selfish resource utilization. Experimental results are presented describing how these mechanisms operate.

The sixth chapter is by B. Tony et al., and gives proof that norms can be shared expectations of behaviours that exist in human societies and can help societies by increasing the predictability of indi-

vidual behaviours and by improving cooperation and collaboration among members. Norms have been of interest to multi-agent system researchers as software agents intend to follow certain norms. But, owing to their autonomy, agents sometimes violate norms, which needs monitoring. In order to build robust MAS that are norm compliant and systems that evolve and adapt norms dynamically, the study of norms is crucial. Their objective is to propose a mechanism for norm emergence in artificial agent societies and provide experimental results. They also study the role of autonomy and visibility threshold of an agent in the context of norm emergence.

In the last chapter in this section, S. DeLoach and M. Kumar present an overview of the multi-agent systems engineering methodology for analyzing and designing multi-agent systems. This methodology has been used to design systems ranging from a heterogeneous database integration system to a biologically based, computer virus-immune system to cooperative robotics systems. The authors also provide a case study of an actual system developed using their methodology in an effort to help demonstrate the practical aspects of developing such systems.

The last section consists of six chapters which are related to *Fuzzy-based and other Methods for Integration*.

The first chapter, by F. Čapkovič, presents an approach based on Petri nets for modeling and analysing agent behaviour. The agents and agent systems are understood here as Discrete-Event Systems (DES). The approach is based on the place/transition Petri Nets (PN) that yield both the suitable graphical or mathematical description of DES and the applicable means for testing the DES properties, as well as for the synthesis of the agent's behaviour. The reachability graph of the PN-based model of the agent system and the space of feasible states are found. Control interferences are obtained on the base of the most suitable trajectory chosen from the set of feasible ones.

The second chapter, by M. Tabakow, includes a novel method of using fuzzy segmentation for color image enhancement to computed tomography perfusion images. The proposed image processing is used to improve the radiological analysis of the brain perfusion. Color image segmentation is a process of dividing the pixels of an image in several homogenously colored and topologically connected groups, called regions. As the concept of homogeneity in a color space is imprecise, a measure of dependency between the elements of such a space is introduced. The proposed measure is based on a pixel metric defined in the HSV color space. By this measure a fuzzy similarity relation is defined, which next is used to introduce a clustering method that generates a partition and so a segmentation. The achieved segmentation results are used to enhance the considered computed tomography perfusion images in purpose to improve the corresponding radiological recognition.

G. Vincenti's and G. Trajkovski's chapter presents a fuzzy mediation method for shared control and online learning. Fuzzy mediation differentiates itself from other algorithms, as this approach is dynamic in nature. The experiments reported in this work analyze the interaction of two distinct controllers as they try to maneuver an artificial agent through a path. Fuzzy mediation functions as a fusion engine to integrate the two inputs to produce a single output. Results show that fuzzy mediation is a valid method to mediate between two distinct controllers. The work lays the foundation for the creation of an effective tool that uses positive feedback systems instead of negative ones to train human and nonhuman agents in the performance of control tasks.

In the fourth chapter, A. Jatowt et al. present a method for analysing data stored in Web archives which preserve content of the Web, and investigating the methodology required for successful knowledge discovery from this data. The Web is a useful data source for knowledge extraction, as it provides diverse content virtually on any possible topic. They call the collection of such Web archives past Web, a temporal structure composed of the past copies of Web pages. First, they discuss the character of the data and explain some concepts related to utilizing the past Web, such as data collection, analysis and

processing. Next, they introduce examples of two applications, temporal summarization and a browser for the past Web.

The next chapter is by D. Król and proposes a generic framework in C# to distribute and compute tasks defined by users. Unlike the more popular models, such as middleware technologies, his multi-node framework is task-oriented desktop grid. In contrast with earlier proposals, this work provides simple architecture to define, distribute and compute applications. The results confirm and quantify the usefulness of such ad-hoc grids. Although significant additional experiments are needed to fully characterize the framework, the simplicity of how they work in tandem with the user is the most important advantage of his current proposal.

And, last but not least, the chapter by X. Xie et al. includes an interesting survey on the application of economic and market theory for grid computing. In recent years, it has been observed that commercial companies are slowly shifting from owning their own IT assets in the form of computers, software and so forth, to purchasing services from utility providers. Technological advances, especially in the area of grid computing, have been the main catalyst for this trend. The utility model may not be the most effective model and the price still needs to be determined at the point of usage. In general, market-based approaches are more efficient in resource allocations, as it depends on price adjustment to accommodate fluctuations in the supply and demand. Therefore, determining the price is vital to the overall success of the market.

The material of each chapter of this volume is self-contained. The editors hope that the book with many papers provided by leading experts from all over the world can be useful for graduate and PhD students in computer science; participants of courses in Knowledge Management, Collective Intelligence, and Multi-agent Systems; and researchers and all readers working on knowledge management and intelligent systems.

The editors would like to thank the authors who present very interesting research results in their chapters. We are indebted to them for their reliability and hard work done in due time. We are looking forward to the same fruitful collaboration during the next edition, which is planned for the near future. We cordially thank the reviewers for their detail and useful reviews. Special thanks are also given to the IGI Global Team members for their friendly help and excellent editorial support in preparing the final version of this volume.

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