Preface

Since its recent inception as a structured field, knowledge engineering has been recognized as the most essential tool for universal knowledge workers. The concept of knowledge engineering, starting with its deep association with information management, still carries multiple, even conflicting interpretations. The most popular one being a structured field that encompasses processes and techniques for knowledge discovery, indexing, organization, and fusion. Where the classical approach to knowledge engineering tends to rely on techniques like concept maps, hypermedia and object-oriented databases, computational intelligence techniques for core knowledge engineering activities like knowledge discovery, organization, and knowledge fusion are rapidly gaining popularity. In the evolved scenario, knowledge engineering may be interpreted as a field that deals with acquisition, storage and application of knowledge for a range of knowledge intensive tasks – whether it is decision support, learning or research support. A very recent trend is the fast emergence of a second generation of knowledge engineering. This is quite interesting and has two thrusts. The first thrust is the people-centric focus on how knowledge is used by people to handle situations effectively (sense making, decision making, execution, and monitoring). The second thrust involves the application of intelligent inanimate processes.

This volume comprising of 12 chapters is an attempt to present some of the latest theoretical and application developments in the field of knowledge engineering. Each chapter focuses on different aspects of knowledge engineering and is complete by itself. The Volume is organized as follows:

The design of knowledge bases by reusing existing ontologies provides several advantages: the design is simpler, the resulting representation semantics is clearer and the knowledge can be shared more reliable. However, the process is not straightforward. In Chapter 1 authors present a solution to this problem by extracting specific concepts from some unified terminology server and by combining them with generic concepts from some ontology.

Chapter 2 presents the main properties of narrative knowledge representation language, a conceptual modeling formalism that takes into account the semantic characteristics of narrative multimedia documents. In the ‘narrative’ documents, the main part of the information consists in the description of the ‘events’ (in the most general meaning of this word, including then states, actions, and situations) that relate the real or intended behavior of some ‘actors’ (characters, personages…). Narrative knowledge representation language employs several representational principles (concepts under the form of frames, templates that define general classes of elementary events, and second order binding structures) and several high-level inference tools. In addition to the theoretical framework of the language and some simple coding schemes author has illustrated high level inference procedures using an example.

Chapter 3 illustrates a methodology for generation of diagnostic knowledge based on meta-knowledge about the task of diagnosis. Two factors favor the use of meta-knowledge in current and future knowledge based systems. First, the amount

of meta-knowledge associated with a domain is much smaller than the corresponding object knowledge. The second factor is that most meta-knowledge is domain independent thus making it applicable to more than one application and domain. The proposed approach is validated using a diagnostic system developed to diagnose faults in a digital electronics application.

For problem environments in which the rules that determine the system are unknown, the prediction of the parameter values that determine the characteristic behavior of the system could be a problematic task. In Chapter 4, authors present a hybrid neural network – case-based reasoning strategy for modeling a complex system that could forecast, in real time, the physical parameters of a dynamic environment. Case adaptation in the case-based reasoning system is achieved by a radial basis function neural network.

Chapter 5 illustrates a novel method to analyze artificial neural networks so as to gain insight into their internal functionality. The authors show how they use their method to analyze some feed-forward–error-back-propagation neural networks for image processing. The networks processing units are described in terms of domain-dependent basic functions. In the case of the digital image processing domain, differential operators of various orders and with various angles of operation are very suitable as basic functions with which the neural network's functionality can be illustrated. Some other pixel classification techniques are analyzed in the same way, enabling easy comparison.

Chapter 6 presents a context based adaptive decision support system based on contextual graphs for problem solving on subway lines. Contextual graphs were designed to represent the domain knowledge and reasoning. Contextual graphs are oriented non-cyclic graphs with exactly one root and one end node and are represented in different ways depending on the context. The graphs also contains the various different possible methods which may be used to carry out the task. Conversely to many conventional approaches, the choice of a particular method is not made at the design time, but dynamically during the accomplishment of the task, depending on the context.

Although knowledge management is primarily concerned with, how people and organizations utilize their knowledge asset, one key to doing so efficiently is to employ technology to facilitate the knowledge management process. One particular kind of technology has shown itself to be extremely useful in this context – specifically the technology of knowledge-based systems. Chapter 7 focuses on applications and issues of knowledge-based systems tailored to knowledge management problems. Authors have demonstrated the relationship of knowledge management to knowledge-based technology and provided an exposition of three fundamental knowledge based methodologies that can facilitate knowledge management – expert systems, case-based reasoning and ontologies.

Chapter 8 describes the various approaches to knowledge representation that have been developed in the applied area of intelligent educational software. The main knowledge representation task in this application area is the construction and maintenance of *student models*: collections of relevant facts about the skills, knowledge and other traits of the students who use the software. The various knowledge representation problems that arise due to the dynamic, real time nature

of the student modeling are presented in detail. Further, the author has demonstrated that modeling only the behavior of a student can still lead to effective automated teaching strategies.

The purpose of Chapter 9 is to show how knowledge engineering techniques has helped to produce models in elaborating computer tools for improvement in road safety analysis and to design flexible systems. A hybrid approach of knowledge engineering has been implemented to design a diagnosis aid system to help experts for detailed analysis of accidents. KADS/CommonKADS method is used to design a computer system to help geographically dispersed analysts for on-site analysis.

Chapter 10 presents a brief survey of the various intelligent techniques for e-commerce namely expert systems, case-based reasoning and multi-agent systems. Multi-agent e-commerce is further focused with some detailed investigation of multi-agent brokerage system. A hybrid framework comprising content-based reasoning, multi-agent system and brokerage is also illustrated.

Chapter 11 introduces a robust mathematical formalism for the definition of deliberative agents implemented using a case-based reasoning system. The concept behind deliberative agents is introduced and the case-based reasoning model is described using this analytical formalism. Variational calculus is introduced to facilitate the agents for planning and re-planning their execution time, so they can react to the environmental changes in real time. Authors also propose the deployment of an intelligent agent to help tourists organize their holidays on the move using wireless communication systems.

Chapter 12 presents the neuro-fuzzy knowledge integration applied to toxicity prediction. Classification of the toxicity correlated to the descriptors for organic compounds requires a high degree of experience from computational chemistry experts. Many algorithms have been proposed to explain toxic effects in different situations, with homogeneous classes of chemicals and considering a specific activity at a time. However, in most cases these algorithms are only suitable for predictions within the structure space spanned by the set of compounds used to build the model. The advantages of developing hybrid models to combine implicit and explicit knowledge as neuro-fuzzy rule-based structures are illustrated in the chapter.

We are very much grateful to the authors of this volume and to the reviewers for the tremendous service by critically reviewing the chapters. The editors would like to thank the publisher for the editorial assistance and excellent collaboration to produce this important scientific work. We hope that the reader will share our excitement to present this volume on ‘Innovations in Knowledge Engineering’ and will find it useful.

Volume Editors

R.K. Jain
A. Abraham
C. Faucher
B.J. van der Zwaag