Preface

The Web has sparked renewed interest in developing intelligent information systems that enable users to accomplish complex tasks in Web-centric environments with relative ease. Although artificially intelligent (AI) technologies such as expert systems and neural networks have been successfully used in aerospace, communication, medical, and financial applications, they have not made a significant impact on improving overall productivity due to their narrow scope. In contrast, the new breed of "intelligent information technologies" hold greater potential in that they can be applied to a large number of domains and a diverse set of problems. A generic intelligent-agent-based application, for instance, can be customized for different domains and a variety of problem scenarios. Several enabling technologies and techniques such as agent-based modeling, grid computing, data mining and knowledge discovery, data warehousing and business intelligence, fuzzy computing, machine learning and evolutionary algorithms, business components, and ontologies are being utilized in creating intelligent systems.

Intelligent-agent technology is emerging as one of the most important and rapidly advancing areas. Researchers are developing a number of agent-based applications and multi-agent systems in a variety of fields such as electronic commerce, supply-chain management, resource allocation, intelligent manufacturing, mass customization, industrial control, information retrieval and filtering, collaborative work, mobile commerce, decision support, and computer games. Research on various aspects of intelligent-agent technology and its applications is progressing at a very fast pace. Specifically, issues related to agent design, implementation, integration, deployment, evaluation and business value are actively being investigated. The authors of this book present some of the research results and application of agents and other intelligent-information technologies in various domains.

Chapter I, "OABIS: An Ontology-Based Approach to Business Rules Sourcing in Supply Chain Management Systems," by Sudha Ram and Jun Liu of the University of Arizona (USA), proposes an ontology-based approach to implementing the data-sourcing service for business rules. Business rules represent guidelines about how an enterprise should conduct its business and provide better service for customers. These rules are widely deployed in supply chains to support real-time decision making. This chapter presents a dynamically adaptable data-sourcing service for deploying business rules effectively in supply-chain management. It captures the semantics of business rules and provides an agent-enabled mechanism that dynamically maps business rules to individual database schemas in the supply chain. Data-sourcing services are important because the execution of business rules requires data to be retrieved from various data sources spread across the enterprise, including the enterprise data warehouse.

Chapter II, "Evolution and Mutation in Push Technologies: Social Concerns Resulting from the Effects of Memes on Intelligent Agents," by Julie Kendall and Kenneth Kendall, of Rutgers University (USA), raises awareness of the movement toward push technologies deploying evolutionary agents and the social implications their use entails. Push technologies are now back in vogue and RSS feeds and Podcasts are now part of many people's daily lives. Software robots, called autonomous agents, are helping users download what they want from the Internet. These agents will change as the user changes and are therefore referred to as an evolutionary agents. Evolutionary agents will also change, because memes (or messages) one agent broadcasts to another, will cause the evolutionary agent to mutate. This chapter explores the social implications of meritorious and malevolent memes exchanged by evolutionary agents. Since interactions occur among humans, evolutionary agents, and memes, the authors raise the following questions for future research regarding genetic determination of evolutionary agents. Is it possible to predict whether a meme will be meritorious or malevolent? Is it desirable to legislate the evolution of agents that are evolved from malevolent memes?

Chapter III, "Approaches and Tools to Optimize and Manage Clinical Processes," by Rainer Herrler, University of Würzburg (Germany), and Christian Heine, University of Hohenheim (Germany), shows how to optimize processes in hospitals by using agent-based simulation and agent-based information systems that can substantially increase the efficiency of hospital process management. In particular, it describes a methodology for optimization; the ingredients of the simulation; the architecture of a management system; and the integration of existing FIPA, DICOM, and HL7 standards. It also provides example scenarios to demonstrate how simulation can improve distributed scheduling and how agent-based systems can be used to manage "clinical trials."

Chapter IV, "Combining Malaria: A Complex System and Agent-Based Approach," by Narjès Bellamine-Bensaoud of University La Manouba (Tunisia) and Fatima Rateb of University College London (UK), investigates how complexity theory

and more particularly how agent-based modelling and simulation can benefit the explanation of the impact of education on malaria healthcare. The proposed model takes into account the environment encompassing mainly cities, roads, hospitals, and schools. Agents, modelling the human actors, can be safe or infected by malaria according to their location in the environment. A modelled agent can also be mobile, can reproduce, and can die. Four kinds of simulation experiments over a 50-year period were conducted. The results show susceptible and immune populations in a "cyclic" fluctuation form and confirm the positive impact of both education and hospitals in combating malaria.

Chapter V, "An Intelligent Multi-Robot System Using Higher-Order Mobile Agents," by Yasushi Kambayashi of the Nippon Institute of Technology (Japan) and Munehiro Takimoto of the Tokyo University of Science (Japan), presents a framework for controlling intelligent robots connected by communication networks. This framework provides novel methods to control coordinated systems using higher-order mobile agents, which are hierarchically structured agents that can contain other mobile agents. By using higher-order mobile agents, intelligent robots in action can acquire new functionalities dynamically as well as exchange their roles with other colleague robots. The higher-order property of the mobile agents enables them to be organized hierarchically and dynamically. In addition, higher-order mobile agents require minimum communication and only need connection when they perform migration.

Chapter VI, "Instrument Validation for Strategic Business Simulation," by Chris Langdon of the University of Southern California (USA), provides a synopsis on the design science of agent-based modeling and how to adapt an agent-based research strategy for the scientific study of complex business systems. Research in information systems (IS) has begun to advance knowledge in the use of agent-based systems as a means to seek different, computational explanations for business phenomena that have eluded scientific inquiry reliant on traditional law and axiomatic explanation. The focus on business problems requires a different research approach than what is successful in computer science. One key modification is to make instrument validation explicit. This chapter extends the discussion on validation to ensure the rigor of management science research in agent-based information systems.

Chapter VII, "Challenges of the 'Global Understanding Environment' Based on Agent Mobility," by Vagan Terziyan of the University of Jyvaskyla (Finland), discusses the Global Understanding Environment as an enabling agent-driven semantic platform for implementation of the heterogeneous industrial resources, condition monitoring, and predictive maintenance. Services are semantic Web-enabled and form a service network based on internal and external agents' platforms, which can host heterogeneous mobile agents and coordinate them to perform the needed tasks. The concept of a "mobile service component" assumes not only exchanging queries and service responses but also delivery and composition of a service provider

itself. A mobile service component carrier (agent) can move to a field device's local environment (embedded agent platform) and perform its activities locally. Service components improve their performance through online learning and communication with other components. This chapter presents one possible implementation framework for such Web services. It also discusses the main challenges of such an environment, which are "semantic adapters" for industrial objects, diagnostic models exchange and integration, distributed trust management, and the concept of a human as a Web service.

Chapter VIII, "Building Sound Semantic Web Frameworks for Scalable and Fault-Tolerant Systems," by Thomas Biskup, Nils Heyer and Jorge Marx Gómez, Carl von Ossietzky University Oldenburg (Germany), introduces hyperservices as a unified application model for semantic Web frameworks and proposes the WASP model as a framework for implementing them. Hyperservices are based on agent societies, provided with structured information by the semantic Web, and using Web services as a collaboration and communication interface. The WASP model adds personalization rules to modify the agents' perception and the HIVE architecture as semantic information server infrastructure within this framework. The conceptual model driven software development is proposed as a means of easy adoption to Hyperservices.

Chapter IX, "Information Parallax," by Franc Grootjen and Theo van der Weide of Radboud University Nijmegen (Netherlands), discusses a special kind of knowledge representation based on a dual view on the universe of discourse and shows how it can be used in human activities such as searching, in-depth exploration, and browsing. This chapter provides a formal definition of dualistic ontologies and exemplifies this definition with three different (well-known) kinds of ontologies, based on the vector model, formal concept analysis, and fuzzy logic respectively. The vector model leads to concepts derived by latent semantic indexing using the singular value decomposition. Both the set model and the fuzzy set model lead to formal concept analysis, in which the fuzzy set model is equipped with a parameter that controls the fine-graining of the resulting concepts. The chapter also discusses the relation between the resulting systems of concepts and demonstrates the use of this theory by introducing the dual search engine. This search engine can be employed to support various human activities.

Chapter X, "ADAM: An Automatic Approach to Database Management," by Sunitha Ramanujam and Miriam Capretz of the University of Western Ontario (Canada), presents a solution to overcome the problem of overburdened and expensive database administrators (DBAs). This chapter focuses on relational database management systems in particular and proposes a novel and innovative multiagent system (MAS) that autonomously and rationally administers and maintains databases. The multiagent system tool, called ADAM (a MAS for autonomous database administration and maintenance), offers a solution to the problem of overburdened and expensive

DBAs with the objective of making databases a cost-effective option for small- and medium-sized organizations. An implementation of the agent-based system to proactively or reactively identify and resolve a small sub-set of DBA tasks is discussed. Role models describing the responsibilities, permissions, activities, and protocols of the candidate agents and interaction models representing the links between the roles are explained. The Coordinated Intelligent Rational agent model is used to describe the agent architecture and a brief description of the functionalities, responsibilities, and components of each agent type in the ADAM multiagent system is presented. A prototype system implementation using JADE 2.5 and Oracle 8.1.7 is presented as evidence of the feasibility of the proposed agent-based solution for the autonomous administration and maintenance of relational databases.

Chapter XI, "Towards Distributed Association Rule Mining Privacy," by Mafruz Zaman Ashrafi, David Taniar, and Kate Smith of Monash University (Australia), proposes a methodology for privacy preserving distributed association rules generation. To explore and analyze large data repositories and discover useful actionable knowledge from it, modern organizations use a technique known as data mining, which analyzes voluminous digital data and discovers hidden but useful patterns within this data. These hidden patterns have statistical meaning and may often disclose some sensitive information. As a result, privacy becomes one of the prime concerns in the data-mining research community. Since distributed data mining discovers rules by combining local models from various distributed sites, breaching data privacy happens more often than it does in centralized environments. The proposed approach employs a secure multiparty computation-based technique that maintains the private inputs of each participating site secret when all participating sites generate the global frequent itemset. The performance evaluation shows that the overall communication cost incurred by the proposed method is less than that of count distribution (CD) and Distributed Mining Association (DMA) rule algorithms.

Chapter XII, "A Generic Internet Trading Framework for Online Auctions," by Dong-Qing Yao, Towson University (USA), Haiying Qiao, University of Maryland (USA), and Haibing Qiao, FileNet Corporation (USA), introduces a generic Internet trading framework for online auctions. A generic OR/XOR bidding language that expresses different OR/XOR combinations is adopted for web interfaces. The framework is implemented with free open-source technologies already successfully tested in different industries. This platform can be used to implement different electronic market mechanisms, and simulate the market behavior of interests under different experimental settings. The auction platform also provides a rule engine. Instead of coding the rules in different places such as agents, the rule engine provides centralized rule management in conjunction with the process-flow engine. This alleviates the auction developer or agent developer from the burden of implementing these rules in a number of places.

Chapter XIII, "Monitoring and Enforcing Online Auction Ethics," by Diana Kao of the University of Windsor (Canada) and Shouhong Wang of the University of Massachusetts Dartmouth (USA), discusses ethics-related issues that are relevant in online auctions and recommends a code of ethics that could be applied to online auctions. Although using a different mode for conducting auction activities, online auctions should abide by the same code of ethics outlined in the face-to-face auction environment. The unique features of online auctions present an opportunity to address how ethical conduct should be supported, monitored, and enforced in an online auction environment. With technology being the backbone of online auction, information systems serve as a useful tool in facilitating ethics enforcement. This chapter presents a model for an information system that supports and enhances ethical conduct in an online auction environment.

Chapter XIV, "Mail Server Management with Intelligent Agents," by Charles Willow of Monmouth University (USA), presents an agent-based solution for managing mail servers. One of the difficulties faced by IS managers is accurately forecasting the memory needs of the organization. In particular, managers are often confronted with maintaining a certain threshold amount of memory for a prolonged period. However, this constraint requires more than technical and managerial resolutions, encompassing knowledge management for the group, eliciting tacit knowledge from the end users, and requiring pattern and time series analyses of utilization for various applications. This chapter summarizes current methods for managing server memory by incorporating intelligent agents. Specifically, a new framework for building a set of automated intelligent agents with neural networks is proposed using the client-server architecture. The emphasis is on collecting the needs of the organization and acquiring the application usage patterns for each client involved in real time. The proposed framework takes into account platform independence, portability, and modularity.

Chapter XV, "Predicting Protein Secondary Structure Using Artificial Neural Networks and Information Theory," by Saad Osman Abdalla Subair of Al-Ghurair Univetsity (UAE), and Safaai Deris of the University of Technology Malaysia (Malaysia), describes a new method for predicting protein secondary structure from amino-acid sequences. Protein secondary structure prediction is a fundamental step in determining the 3D structure of a protein. The newly developed method utilizes the knowledge of GOR-V information theory and the power of neural networks to classify a novel protein sequence in one of its three secondary structure classes—helices, strands, and coils. The NN-GORV-I method is further improved by applying a filtering mechanism to the searched database and hence named NN-GORV-II. The Cuff and Barton 513 protein data set is used for training and testing the prediction methods under the same hardware platform, and environment. The developed prediction methods are rigorously analyzed and tested together with other five well-known prediction methods to allow for easy comparison.

Agent-based applications and intelligent information technologies are beginning to be widely used by individuals and organizations alike. Many mission-critical applications are being developed for the purpose of improving productivity and gaining competitive advantage and facilitating growth and success for both organizations and individuals. Effective use of intelligent information technologies becomes a necessary goal for all, and this may be accomplished by learning from the research and advances of others within the intelligent-information-technologies field. An outstanding collection of the latest research associated with intelligent agents and information technologies has been presented in this book. Use of intelligent-information technologies has the potential to revolutionize the work environment as well as social computing.

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Application of Agents and Intelligent Information Technologies

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