Preface

This book is an anthology of articles that were published in the inaugural volume of the *International Journal of Organizational and Collective Intelligence*, which provide researchers and practitioners in the communities of computer and information sciences with a forum to advance the practice and understanding of computing theories and empirical analyses as sound technical solutions for realizing “intelligent organizations,” i.e., intelligent computing for organizational information from not only technical but also institutional and social aspects. Collective Intelligence (CI) is discussed in many related disciplines including biology, sociology, natural and environmental sciences, physics, etc. in conjunction with computer science. CI-related computational and system engineering design and implementation methodologies of CI-based systems gives a variety of case studies which are directed towards the Social Web, as a very prominent example of synergistic interactions of a group of people as a platform for the emergence of truly CI-based systems of diverse applications in cultural and professional backgrounds.

Collective intelligence is a cross-disciplinary subject of challenge-based research of modern computer science. The current environments and resources surrounding global enterprises and dynamic organizations demand rational theories and reliable applications, which allow technically sound solutions and uniformly implement proper functions to their managerial issues. Those issues on organizational management need trans-disciplinary solutions not given by any single theory or application, like Information and Knowledge Computing, Knowledge Management, Knowledge Bases, Decision Science, Semantic Web, Organizational Systems, Middleware, Applications and Experiences, Enterprise Security, Global Enterprise Systems, Artificial Intelligence, Robotics, etc. We should have a uniformed theory and its applications for intelligent organizations by integrating and implementing those individual solutions. The first volume comprises various topics, which include knowledge computing, knowledge management, decision science, semantic Web, organizational systems, security, enterprise systems, AI, and robotics, and discuss those subjects only from the technical aspects. The Journal makes great advances as a forum of practical and theoretical discussions on those technologies and solutions from the trans-disciplinary or cross-disciplinary aspects of science and technology with respect to social dynamics and institutional analysis including global solutions of intelligent organizations practicing knowledge management, implementing decision support systems, collaborative applications with other technical areas, and so on.

This book spins off the success of the journal, and its wide range of topics from computing theories to empirical analyses of intelligent organizations reflect current technical achievements in a variety of solutions in knowledge computing, knowledge management, decision science, semantic Web, organizational systems, security, enterprise systems, AI, and robotics from both technical and managerial aspects. The research of collective intelligence is a hot issue in the twenty-first century, because the recent expansion of network connectivity to the Internet, known as ubiquitous environment, allows people in enterprises and organizations to enjoy a number of contents and programs stored in the digital forms, which wait for dynamic and intelligent organization and analysis by technical solutions automatically. The advent of new technical solutions in those individual areas discussed above begs one to question whether their applications to enterprises and organizations are proper solutions from not only a technical but also an institutional perspective, in the context of organizational information from managerial
aspects. Facing that issue, one needs proper technical solutions in social and organizational dynamics, those in the technical fields have been aware of a necessity of a specific forum to offer an interdisciplinary or trans-disciplinary journal for leading researchers and practitioners with both technical backgrounds and managerial experiences to tackle the research of collective intelligence. In this book, practical and theoretical contributions on various topics are discussed from the latest aspects, while they are focusing on the technological, social, and global dynamics of intelligent organizations practicing knowledge management, implementing decision support systems, collaborative applications, and so on.

This book is designed to give insights of collective intelligence and its practical solutions in computer science to researchers and practitioners including graduate students who study computer science, information engineering, system engineering, information studies, and management of information technology in the fields of Information and Knowledge Computing, Knowledge Management, Knowledge Bases, Decision Science, Semantic Web, Organizational Systems, Middleware, Applications and Experiences, Enterprise Security, Global Enterprise Systems, Artificial Intelligence, Robotics, etc. Another target is researchers and students who work for professional degrees in business schools, management schools, public policy schools, or their equivalents. The book helps its audience in the above technical fields to learn which technical solution has sound reasoning and proper application to their current demands, which is not available in any other books. Meanwhile, for an audience in managerial fields, it is easy to access and understand individual technical solutions from their familiar words of management.

The book focuses on computing theories and empirical analyses of organizational intelligence and collective intelligence. The mission of its publication is to provide researchers and practitioners in the communities of computer and information sciences with a forum to advance the research on collective intelligence, i.e., intelligent computing for organizational and collective information. The book reflects the current technical achievements in a variety of solutions, which question whether their applications to enterprises and organizations are proper solutions from not only a technical but also from institutional aspects. The organizational intelligence and collective intelligence are cross-disciplinary subjects of challenge-based research on modern computer science, which demand trans-disciplinary solutions given by not any single theory or application but by the integration and implementation of the individual solutions discussed below as exemplary but not exhausted:

- Soft Computing in Organizations
- Game Theoretic and Information Economic Analysis
- Data Mining and Knowledge Bases for Organizational Management
- Classification and Clustering
- Optimization
- Machine Learning
- Neural Networks, Bayesian Networks, Fuzzy Techniques and Systems
- Genetic Algorithms and Evolutionary Computing
- Self-organizing and Complex Systems
- Knowledge Discovery
- Service Computing
- Organizational Systems, Middleware, Applications and Experiences
- Semantic Web Architecture and Applications
- Intelligent Web-Based Systems
- Intelligent Agents and Multi-Agent Systems
- Decision Science, Decision Making Theory and Modeling
• Decision Support Systems and Crisis Management Systems
• Collaboration and Communication Systems
• Artificial Intelligence for Organizational Management
• Security and Access Control
• Machine and Computer Vision
• Robotics for Intelligent Organizations
• Information and Knowledge Computing (including applications)
• Soft Computing in Organizations
• Collective Intelligence for Organizational Management
• Game Theoretic and Information Economic Analysis
• Monitoring and Planning
• Industrial Control
• Fault Diagnosis
• Traffic and Communication Optimization
• Financial and Stock Market Monitoring and Prediction
• Digital Ecosystems
• Intelligent Web-Based Systems
• Pervasive Computing
• Intelligent Web Personalization
• Mobile Computing and Systems
• Business Intelligence Systems
• Medical and Diagnostic Systems
• Context-Aware and Affective (Emotional) Computing
• User Profiling
• Knowledge Management for Organizational Management
• Classification and Clustering
• Optimization
• Statistical Approaches for Large Scale Date
• Data Mining
• Visual and Audio Data Mining
• Web Mining
• Link and Graph Mining
• Knowledge Synthesis and Visualization
• Information Extraction
• Information Filtering
• Information Integration
• Recommender Systems
• Knowledge Bases for Organizational Management
• Machine Learning
• Neural Networks
• Bayesian Networks
• Artificial Immune Systems
• Fuzzy Techniques and Systems
• Genetic Algorithms and Evolutionary Computing
• Self-Organizing and Complex Systems
• Intelligent Agents and Multi-Agent Systems
• Virtual Reality and Multi-Media Intelligent Information Systems
• Knowledge Discovery
• Data Analysis and Pattern Recognition
• Knowledge Representation and Management
• Knowledge Acquisition
• Computational Neuroscience
• Intelligent Web Mining and Applications
• Decision Science
• Decision Making Theory and Modeling
• Collaborative Solutions
• Fairness Solutions
• Decision Support Systems
• e-Auction Systems and e-Negotiation Systems
• Decision Support and Visualization
• Semantic Web for Organizational Management
• Organizational Systems, Middleware, Applications and Experiences
• Collaboration and Communication Systems
• E-commerce Systems
• Enterprise Resource Planning
• Supply Chain Management
• Web Conferencing
• Enterprise Security
• Intelligent and Secure Information Systems
• Security and Access Control
• Data Privacy
• Cryptography
• Machine and Computer Vision
• Visualization and Virtual Technologies for Intelligent Organizations
• Visualization and Virtual Reality on Medical and Health Care Organizations
• Visualization and Virtual Reality on Financial Services
• Service Computing
• Artificial Intelligence for Organizational Management
• Intelligent Agent-based Systems
• Cognitive and Reactive Distributed Management Systems
• Mobile, Ad Hoc, and Sensor Network Management
• Skill Sciences
• Robotics for Intelligent Organizations
• Biology and Medicine
• Business and Management
• Artificial Societies
• Chemicals, Pharmaceuticals and Materials
• Environment Engineering
Collective intelligence has its promising fields of applications as solutions. This book dedicates two specific fields of solutions: service computing and knowledge management.

Service-oriented solutions are appreciated in collective intelligence that is built in enterprise information systems. Many research works on services provision involve cross-disciplinary approaches. Its typical framework is found in business-to-business process collaboration with three layers: collaboration requirements layer, business rule layer, and system implementation layer. Those layers allow users to specify the cross-organizational requirements of e-service processes and define detailed knowledge of process collaboration requirements as business rules in a unified Event-Condition-Action (ECA) and from with technical support of event collaboration interfaces by contemporary Enterprise JavaBeans and Web Services. This approach gives a seamless definition to enact and enforce B2B process collaboration with conceptual models of various layers in the Unified Modeling Language (UML) and a running example based on a supply-chain process. We evaluate our approach from the perspective of three main stakeholders of e-collaboration, namely users, management, and system developers.

Beyond the Services Oriented Architecture (SOA), intelligent computing is essential to achieve excellent services for requirements in computation environments. This phenomenon demands knowledge integration from various disciplines such as computer science, industrial and systems engineering, management science, operations research, and so on. Since the beginning of SOA paradigms, with its various implementation technologies such as Web services, the focus of industrial communities has been on providing tools that would allow seamless and flexible application integration within and across enterprise boundaries. A new paradigm demands a method, which is to guide service engineers in their choices of identifying, defining, and analyzing adaptable business services. Such method is business-centric and comprises a set of structured steps grouped in two phases, embracing model-driven architecture principles to model and refining adaptable business services models.

Some chapters in this book discuss challenges and solutions to service-oriented intelligent computing. So-called killer applications are required to drive Web services and systems in the field of intelligent service computing. A fundamental system for service computing is Web-based solutions, which go forward and elevate to the stages of Web 2.0, Web 3.0, and so on. Web 2.0 refers to the second-generation platform, facilitating communications, information sharing, interoperability, and collaboration. Virtual systems and virtual communities work together with autonomous or peer-to-peer systems of communications under this direction. A wide range of intelligent services and analyses are applicable to many solutions as hot issues from the aspects of collective intelligence. The emergence of Web 2.0 has brought along the trend of community. It is also the trend that contributes to socialization of the Internet. The essence of Web 2.0 is creation and sharing, which give rise to social networking communities such as Blogs, Wikipedia, and Facebook. Through Wikipedia, Blogs, Facebook, and other kinds of social networking websites, interactive relationships and bridges of knowledge sharing have been built up successfully. This book attempts to propose an effective way to locate people with shared interests. By using Internet resources bookmarked by the users, the similarity of interests between them can be analyzed. Based on this relationship, people can build communities. Also, through community activities, the innovation and exchange of collective intelligence are accomplished.

Those emerging systems and architectures have brought intelligent services into various domains, such as context-aware services. They also increase complexities of system design. For example, existing identity meta-systems provide enabling tools to manage, select, and control digital identities but they have not provided the support of trust management that should cover how trust requirements associated with digital identities are modeled, how runtime conditions for trust are evaluated, and how the results of trust evaluation are consumed by systems/applications. A new approach toward trust management is to enable
such identity meta-systems that cover analysis of trust requirements and development of trust management systems in a consistent manner. Trust management architectures extend the existing identity meta-systems by introducing computing components for carrying out typical trust management tasks associated with digital identities. The computing components in such architectures provide intelligent services for these tasks and realize automation of the development of trust management layer for digital identities.

Agent-based technologies are one of the most promising solutions for integration of systems and services in intelligent computing. Agents built in communication systems are autonomous and independent to each other. Various technologies from artificial intelligence are introduced to service computing under the diversity of solutions such as computational intelligence, soft computing, game theory, genetic algorithms, evolutionary computing, logics, machine learning, optimization, and so on. Such solutions are vital for excellence in service computing. Mobile networks are a promising field of application and integration between collective intelligence and service computing. As mobile devices become more powerful and widespread, demand for adaptive solution in mobile computing increases and engineering requirements and design constraints become challenging. For example, grid computing is a high-potential technology for its solution. One of those solutions, which are software as a service, utility computing, and meta-services, is introduced into cloud computing. Cloud computing emphasizes a large collection of services rather than a single product, as shared resources. In cloud computing, there are many open issues to which collective intelligence can provide a solution. In particular, how traditional information systems can be migrated to new cloud platforms is a key issue of its adoption. To empower service computing in systems and services, intelligent computing contributes to various technical problems in collective intelligence. An exemplary solution is decision support systems. Other examples are found in context-based modeling in software available to enterprise systems, which provide intelligent service-oriented systems, trust management, access control on semantic Web using ontologies, insurance modeling to improve trust and service qualities, and knowledge management in community-oriented services. Semantic Web technologies allow on-line resources to be semantically annotated to support more effective and intelligent online services. However, ontologies sometimes may contain sensitive information. Providing access to them requires proper control to ensure the data protection requirement. Yet, the protection should not be too restrictive to make the access management inflexible. While there has been recent work on policy-based access control, a solution to this problem is to provide a policy representation specifically designed for access control on ontology-based data and to explain how issues like policy propagation and policy conflict resolution are addressed. An exemplary measure is found in bucket-based query rewriting algorithms, which realize the access control policies to avoid sensitive resources leakage in the context of semantic Web.

Research in service computing raises concerns of solutions originating from collective intelligence that provides technical solutions to high-level requirements in modeling and designs. Inter-discourse between collective intelligence and service computing brings various insights into a wide range of challenges and opportunities. Trans-disciplinary approaches for implementation of service design and reflection on consumers’ values and decision-making are very productive in the real world with the recent research trends of services and propose a research framework to integrate computer sciences, human sciences, and economics. In a typical way, service computing and collective intelligence are integrated in the context of multi-agent simulation with the advent of a psychological survey on a cognitive model constructed by integration of questionnaire data from retailers using Bayesian networks modeling and price mechanisms design. An integrated and distributed intelligent system is another approach that enables automatic estimation and updates of large-sized economic models based on input-output modeling using a matrix representation of national or regional economy. Its unique distribution in memory allocation allows accurate implementation of large-size models.
Knowledge management is a well-appreciated field in the long-standing tradition of Computer Science and Artificial Intelligence. Information processing and management as well as knowledge engineering principles and techniques have been envisioned and practiced claiming some kind of intelligence in organization, processing, and behavior. Effective memory models and organization have always attracted research and development efforts in an attempt to address the challenges of intelligent behavior in humans and machines. Among the oldest examples are nature-inspired models such as cellular automaton conceived by Ulam and von Neumann in the 1940s, which has been investigated as a framework for the understanding of the behavior of complex systems.

In spite of the controversial opinions about the degrees of success for understanding and applying intelligence, today’s computer impacted culture is characterized by the production and consumption of knowledge and information in an assembly of smaller universes of entities, i.e., people, machines, software, data, computational models, rather than truly intelligent systems. In order to adhere to the evolutionary and cultural impact of computer science in society and organizations, we need to re-visit memory and organizational models within a universe of discourse where entity participation and connectionism are of paramount importance. Data, information, and knowledge management principles and techniques need to be conceived as contributing to the creation of a huge associative memory, which could enable a collectively, eventually truly, intelligent society and organization. Within such a Collective Intelligence (CI) Universe of Discourse, coping with and harnessing complexity and diversity remains a key challenge, which can be met by conceiving data and knowledge engineering and management as an ecosystem underlying synergy and natural selection processes.

For example, data and knowledge engineering principles and techniques are often discussed in a CI Universe of Discourse. Particular emphasis has been given to principles and techniques underpinning all processes from ergonomics, conceptualization, and conceptual modeling to querying, retrieval, and storage of data and knowledge as integral parts of a larger associative memory. Especially, Digital Ecosystems, inspired by natural ecosystems, are a good field for integrating knowledge and data from the aspect of collective intelligence in the contexts of self-organization, scalability, and sustainability, which are of paramount importance for harnessing complexity in large-scale systems, in open social-technical systems. Digital ecosystems give a critical overview of digital counterparts for the behavior and constructs of biological ecosystems, instead of simulating or emulating such behavior or constructs. In this critical view, what parallels can be drawn from bio-aspects in digital systems? For instance, Multi-Agent Systems are discussed in order to explore the references to agents and migration. This is followed by evolutionary computing and Service Oriented Architectures for the references to evolution and self-organization in computing and computational environments rather than natural and environmental ones.

Not only are digital counterparts of self-organization, sustainability, and scalability desirable properties of an ecosystem but also autonomous agent approaches are promising in collective intelligence that is introduced into knowledge management. A way of optimization queries in stream grids is a good exemplary technique for bridging gaps between collective intelligence and knowledge management. Nodes in a grid act as local agents, which try to optimize stream grid queries based on their local interests. In such an ecosystem, it becomes apparent that there cannot be any global optimization strategy, but one emerging out of local optima and choices among alternative strategies. Stream grids are grid-computing environments that are fed with streaming data sources from instrumentation devices like cameras, RFID (Radio-Frequency Identification) sensors, network monitoring, or other applications. Queries by users or applications seek to tap into one or more such streams. The main costs for such queries include bandwidth costs and bookkeeping costs at each grid node. In such scenarios, there are conflicting optimization requirements.
In the context of Peer-to-Peer (P2P) system architectures, management of collective intelligence in semantic communities is a key solution in knowledge management. How queries can be supported once Semantic CoIs form a community level CI with this design architecture that departs from traditional P2P approaches in that there is a shift from a network of units to a network of coalitions where the community itself (and not the peers on their own) has the role to support effective query execution and data availability. This approach also involves creation and maintenance of a community-level collective intelligence in order to push attention to the critical aspects of distributed knowledge management in P2P environments, where the goal of establishing a shared agreement among a set of peers conflicts with the intrinsic P2P nature that pursues peer autonomy, communication scalability, and rapid change propagation.

The discussion of how to improve information management and querying is taken further in a collective setting of multimedia sensor networks, where the handling of a voluminous amount of multimedia sensor data is of paramount importance. Such an approach is to handle the huge and voluminous data generated by an ecosystem of multimedia sensors in a video surveillance context (e.g., supermarket environment). The key idea behind it is to “continuously” construct a 3D representation of the monitored area, in which video streams originating from the video sensors are fused. In other words, the “views” of the sensor nodes are merged in the 3D scene of the monitored region. This approach presents many interesting advantages, in particular for resources limited environments like those of sensor networks. Another advantage of this kind of approach is its ability to answer some spatio-temporal requests that are very hard to handle with raw video data.

Finally, another promising approach is found in challenges and problems for indexing and querying objects on the move with particular interest on predictively querying their future position. In an ecosystem of data, information and knowledge where data or queries are being migrated or moved across networks of communication for the sake of query optimization and effectiveness of information provision, new indexing, and querying techniques are requested.

**IJOCI BEST PAPER OF THE YEAR**

This is our honor and pleasure to announce the first IJOCI annual best paper award, which goes to Sietse Overbeek, Yiwei Gong, and Marijn Janssen’s “Architectures for Enabling Flexible Business Processes: A Research Agenda.” Their article discusses a brand new architecture of process management for business requirements with a brilliant idea that realizes flexibility originating from collective intelligence in organizations. We quote their abstract here.

For decades, information systems have been designed for controlling and managing business processes. In the past, these systems were often monolithic in nature and not made for interacting and communicating with other systems. Today, departments and organizations must collaborate, which requires distributed Web-based systems to support the enactment of flexible business processes. In this chapter, four architectures of process management systems are investigated by studying the components and the relationships with the tasks that make up the business processes. These different architectures support automation of non-repetitive, customized processes, and are compared based on dimensions of flexibility. This evaluation showed that the process orchestration architecture scored best, but still has its shortcomings. The results from the comparison are used for developing a research agenda that includes the suggestion to develop reference architecture for connecting individual architectural components.
We particularly appreciate contributors who have made great commitments with research in collective intelligence. Without their devotion to this field, this book does not exist. In concluding to this preface, we extend appreciation to our friends and colleagues who are involved in this project from review to edition: Akinori Abe, Hisao Ishibuchi, Hiroshi Ishikawa, Ivan Jordanov, Eleanna Kafeza, Shiguo Lian, Yasuo Matsuyama, Tomonobu Ozaki, Shigeo Sugimoto, Takeshi Takenaka, Yuzuru Tanaka, Yin Leng Theng, Ajith Abraham, Tieyan Li, Nikolaos Nikolaidis, Husrev Taha Sencar, Shuiming Ye, Yinghua Ma, Youakim Badr, Fernando Ferri, Agma Traina, Caetano Traina, Maria Luisa Sapino, Mario Koeppen, Shengfeng Qin, Frank Stowell, Antoniya Georgieva, Sanaz Mostaghim, Toshiharu Hatanaka, Edwin Lughoffer, Ferrante Neri, Hisashi Handa, Kevin Kok Wai Wong, Liya Ding, Wenying Liu, Huiye Ma, Wendy W. Y. Hui, Yi Zhuang, Chi Keong Goh, Xiaohui Zhao, Maggie M. Wang, Markus Schaal, Sietse Overbeek, Yuqing Sun, Farid Meziane, Zongwei Luo, Chutiporn Anutariya, Kouzou Ohara, Doina Tatar, Jin-Cheon Na, Takehsu Yamakawa, Fu-ren Lin, Zbigniew Galias, Pierre Levy, Nariaki Nishino, Susan Elias, Chi-hung Chi, G.R. Gangadharan, Koichi Moriyama, Chei Sian Lee, Lei Chen, Yoichi Motomura, Hiroshi Igaki, Raymond Y. K. Lau, Naoki Fukuta, Penny Hart, Yasufumi Takama, Nariaki Nishino, Hsuhe-hua Chen, Akira Maeda, Tsukasa Ishigaki, Carmen Ka Man Lam, Kengo Katayama, Yoshiko Hanada, Haiyang Hu, Sally Jo Cunningham, Nobutada Fujii, Mitsunori Matsushita, Hideaki Takeda, Tetsuo Sakaguchi, Keiichi Horio, Paulo Pinheiro da Silva, Vilas Wuwongse, Hiroshi Igaki, Jim Dimarogonas, P. Radha Krishna, Atsuyuki Morishima, Xi Chen, Ting Yu, Ichiro Kobayashi, Yusuke Nojima, Tomoya Takenaka, and Yu Suzuki. Actually, this is not an exhaustive list, but instead, just a list of people who have come to mind. Nothing could be done without your support. Thank you so much!

Hideyasu Sasaki  
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January 30, 2012