Intelligent Computing Systems

Emerging Application Areas

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There are many real-world problems of such high complexity that traditional scientific approaches, based on physical and statistical modeling of the data generation mechanism, do not prove effective. Typically, these problems are characterized by multidimensionality, nonlinearities, chaotic phenomena and the presence of a plethora of degrees of freedom and unknown parameters in the underlying data-generating mechanism. Additional difficulties in addressing these problems arise from inherent uncertainties, noise and time variability of the context. As a result, loss of information that is crucial to solve a problem is inherent in the data generation process itself, making a traditional mathematical solution intractable.

On the other hand, biological systems have evolved over the ages to address similar problems in biological organisms in very efficient ways. For example, biological neural networks, i.e., networks of interconnected biological neurons in the nervous system of most multi-cellular animals, are capable of learning, memorizing and recognizing patterns in signals such as images, sounds, smells or odors. Similarly, ants exhibit a collective, decentralized, and self-organized intelligence that allows them to discover the shortest route to food in very efficient ways. A third example of a biological system that exhibits high level intelligence is the vertebrate immune system, i.e., a decentralized system of biological structures and processes within an organism that protects against pathogens that threaten the organism and may cause disease.

Intelligent Computing Systems make use of computational methodologies that mimic nature-inspired processes to address real world problems of high complexity for which exact mathematical solutions, based on physical and statistical modelling,

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are intractable. Common intelligent computational methodologies include artificial neural networks, evolutionary computation, genetic algorithms, artificial immune systems, fuzzy logic, swarm intelligence, artificial life, virtual worlds and hybrid methodologies based on combinations of the previous.

Intelligent Computing Systems have appeared in most modern scientific disciplines, including engineering, natural, computer and information sciences, economics, business, commerce, environment, healthcare, and life sciences.

The book at hand is an attempt to explore emerging scientific and technological areas in which Intelligent Computing Systems seem to provide efficient solutions and, thus, may play a role in the years to come.

More specifically, the book at hand consists of an editorial chapter (this chapter) and an additional fifteen (15) chapters. All chapters in the book were invited from authors who work in the corresponding area of Intelligent Computing Systems and are recognized for their research contributions. More specifically, the chapters in the book are organized as follows:

The first part of the book consists of six chapters devoted to intelligent computing systems incorporated in various services provided to government, businesses and communities.

Specifically, chapter "Semantic Tools; Their Use for Knowledge Management in the Public Sector", by Theocharis and Tsihrintzis, is on "*Semantic tools; their use for knowledge management in the public sector.*" The authors present ontology-based intelligent systems towards the development of smart applications, Internet search and knowledge management in government.

Chapter "From Game Theory to Complexity, Emergence and Agent-Based Modeling in World Politics", by Paravantis, is entitled "*From game theory to complexity, emergence and agent-based modeling in world politics.*" The author examines the complexity of world politics with an emphasis on global environmental issues and with use of game theory.

Chapter "A Semantic Approach for Representing and Querying Business Processes", by Kalogeraki, Apostolou, Panayiotopoulos, Tsihrintzis and Theocharis, is on "*A semantic approach for representing and querying business processes.*" The authors present the challenges and benefits associated with the coupling of semantic technologies with business process management and describe a methodology for representing the semantic content of the BPMN specification in the form of ontology.

Chapter "Using Conversational Knowledge Management as a Lens for Virtual Collaboration in the Course of Small Group Activities", by Akoumianakis and Mavraki, is on "*Using conversational knowledge management as a lens for virtual collaboration in the course of small group activities.*" The authors focus on a relatively recent approach to knowledge management and collaborative learning, namely *conversational knowledge management*.

Chapter "Spatial Environments for m-Learning: Review and Potentials", by Styliaras, is on "*Spatial environments for m-learning: Review and potentials.*" The author reviews existing spatial hypermedia interfaces as well as related environments and their potential use in educational platforms for mobile devices.

Chapter "Science Teachers' Metaphors of Digital Technologies and Social Media in Pedagogy in Finland and in Greece", by Vivitsou, Tirri and Kynäslahti, is on "*Science teachers' metaphors of digital technologies and social media in pedagogy in Finland and in Greece.*" The authors discuss and analyze pedagogical decisions and choices when the learning space is enriched with social networking environments, and digital and mobile technologies.

The second part of the book consists of five chapters devoted to intelligent computing systems incorporated in various services provided to smart cities, intelligent energy systems and environmental monitoring.

Specifically, chapter "Data Driven Monitoring of Energy Systems: Gaussian Process Kernel Machines for Fault Identification with Application to Boiling Water Reactors", by Alamaniotis, Chatzidakis and Tsoukalas, is on "*Data-driven monitoring of energy systems: Gaussian-process kernel machines for fault identification with application to boiling water reactors.*" The authors present an approach that adopts a set of Gaussian process-based learning machines in monitoring highly complex energy systems.

Chapter "A Framework to Assess the Behavior and Performance of a City Towards Energy Optimization", by Androulaki, Doukas, Spiliotis, Papastamatiou and Psarras, is on "*A framework to assess the behavior and performance of a city towards energy optimization.*" The authors introduce the Smart City Energy Assessment Framework (SCEAF) to evaluate the performance and behavior of a city towards energy optimization, taking into consideration multiple characteristics.

Chapter "An Energy Management Platform for Smart Microgrids", by Delfino, Rossi, Rampararo and Barillari, is on "*An energy management platform for smart microgrids.*" The authors present a platform to address the important issue of planning and management of a, so-called, smart microgrid, that is a group of interconnected loads and distributed energy resources with clearly defined electrical boundaries that acts as a single controllable entity with respect to the public grid.

Chapter "Transit Journaling and Traffic Sensitive Routing for a Mixed Mode Public Transportation System", by Balagapo, Sabidong and Caro, is on "*Transit journaling and traffic sensitive routing for a mixed mode public transportation system.*" The authors propose transit journaling, a crowdsourcing solution for public transit data collection, and we describe CommYouTer, an Android app for this purpose.

Chapter "Adaptation of Automatic Information Extraction Method for Environmental Heatmaps to U-Matrices of Self Organising Maps", by Markowska-Kaczmar, Szymanska and Culer, is on "*Adaptation of automatic information extraction method for environmental heatmaps to U-matrices of self-organising maps.*" The authors we introduce some dedicated processing steps while trying to minimize the number of changes in previously proposed methods.

The third part of the book consists of two chapters devoted to intelligent computing systems incorporated in equipment.

Specifically, chapter "Evolutionary Computing and Genetic Algorithms: Paradigm Applications in 3D Printing Process Optimization", authored by Canellidis, Giannatsis and Dedoussis, is on "*Evolutionary computing and genetic*

algorithms: Paradigm applications in 3D printing process optimization." The authors present the effective utilization of genetic algorithms, which are a particular class of Evolutionary Computing, as a means of optimizing the 3D printing process planning.

Chapter "Car-Like Mobile Robot Navigation: A Survey", authored by Spanogianopoulos and Sirlantzis, is on "*Car-like mobile robot navigation—A survey.*" The authors review the basic principles and discuss the corresponding categories in which current methods and associated algorithms for car-like vehicle autonomous navigation belong.

In the fourth (final) part of the book, we have included two chapters which provide advanced theoretical tools for processing data in various applications of intelligent computing systems.

Specifically, chapter "Computing a Similarity Coefficient for Mining Massive Data Sets", authored by Cosulschi, Gabroveanu and Sbırcea, is on "*Computing a similarity coefficient for miningmassive data sets.*" The authors analyse the connections and influences that certain nodes have over other nodes and illustrate how the Apache Hadoop framework and the MapReduce programming model can be used for a large amount of computations.

Finally, chapter "A Probe Guided Crossover Operator for More Efficient Exploration of the Search Space", authored by Liagkouras and Metaxiotis, is on "*A probe-guided crossover operator for more efficient exploration of the search space*." The authors propose a new probe-guided crossover operator for the more efficient exploration of the search space through the recombination of the fittest solutions.

In this volume, we have presented some emerging application areas of intelligent computing systems. Societal demand continues to pose challenging problems, which require ever more efficient tools, methodologies, and integrated systems to de devised to address them. Thus, it may be expected that additional volumes on other aspects of intelligent computing systems and their application areas will appear in the future.