Preface

INTRODUCTION

The evolution of nature and biological systems is helping to create new reality with great potential to resolve many research and development challenges. Hence, there is a need to study and examine nature, its models, elements, processes, systems, structures, mechanisms, etc. to take inspiration from, or emulate, nature's best biological ideas and products in order to solve modern science and engineering problems.

Artificial Life is featured as an emerging, interdisciplinary and unifying field of research to study phenomena or abilities of living systems in nature including human and analyze research findings to integrate effectively scientific information for the purpose to develop life like artificial systems and machines that exhibit the autonomous behavioral and characteristics of natural living systems. These systems are normally based on computer simulations and hardware designs of state-of-the-art technologies that span brain and cognitive sciences, the origin of life and living systems, self-assembly and development of evolutionary and ecological dynamics, animal and machine behaviors including robots, social organization, and cultural evolution to improve and comprehend real-world problems.

ORGANIZATION OF THE BOOK

This handbook includes 19 chapters that contribute with the state-of-art and up-to-date knowledge on research advancement in the field of Artificial Life research and development. The chapters provide theoretical knowledge, practices, algorithms, technological evolution and new findings. Furthermore, the handbook helps to prepare engineers and scientists who are looking to develop innovative, challenging, intelligent, bioinspired systems and value added ideas for autonomous and smart interdisciplinary software, hardware and systems to meet today's and future most pressing challenges.

Chapter 1: An Electric Wheelchair Controlled by Head Movements and Facial Expressions

A bio-signal based human machine interface is proposed for hands-free control of a wheelchair. An Emotiv EPOC sensor is used to detect facial expressions and head movements of users. Nine facial expressions and up-down head movements can be chosen to form five commands: move-forward and

backward, turn-left and right, and stop. Four unimodal modes, three bi-modal modes and three fuzzy bi-modal modes are created to control a wheelchair. Fuzzy modes use the users' strength in making the head movement and facial expression to adjust the wheelchair speed via a fuzzy logic system. The developed system was tested and evaluated.

Chapter 2: Innovative Features and Applications Provided by a Large-Area Sensor Floor

This chapter describes new functions, features and applications of the developed capacitive sensor system SensFloor®. The chapter focuses on applications for health care and Ambient Assisted Living (AAL). In addition, the chapter presents applications in other domains as well, such as medical assessments, retail, security and multimedia.

Chapter 3: Reassessing Underlying Spatial Relations in Pedestrian Navigation – A Comparison Between Sketch Maps and Verbal Descriptions

The chapter assesses underlying spatial relations for pedestrian wayfinding by examining and experimenting navigational directions given in both forms of sketch maps and verbal descriptions. The authors were specifically interested in the landmarks and spatial relationships such as route topology, linear order relation and relative orientation extracted from the navigational directions. A new ontological approach to sketch and verbal interpretations was adopted for spatial analysis.

Chapter 4: What Is It Like to Be a Cyborg?

This chapter describes the personal experience of the author experimenting a Cyborg (part biology/part technology) by having technology implanted in his body, which he lived with over a period of time. A look is also taken at the author's experiments into creating Cyborgs by growing biological brains which are subsequently given a robot body. In each case the nature of the experiment is briefly described along with the results obtained and this is followed by an indication of the experience, including personal feelings and emotions felt in and around the time of the experiments and subsequently as a result of the experiments.

Chapter 5: Artificial-Intelligence-Based Service-Oriented Architectures (SOAs) for Crisis Management

This chapter deals with the complexity of crisis-related situations that requires the use of advanced technological infrastructures. In order to develop such infrastructures, specific architectures need to be applied such as the Service-Oriented Architectures (SOAs). The purpose of this chapter is to indicate how SOAs can be used in modern Crisis Management systems, such as the ATHENA system. It also underlines the need for a detailed study of specific biological systems, such as the human brain's hippocampus which follows the current, intense attempts of improvement of the current Artificial Intelligence-based systems and the development of a new area in Artificial Intelligence.

Chapter 6: A Tour of Lattice-Based Skyline Algorithms

There exist many Skyline algorithms which can be classified into generic, index-based, and lattice-based algorithms. The work in this chapter takes a tour through lattice-based Skyline algorithms summarizing its basic concepts and properties, presents high-performance parallel approaches. In addition, it introduces how to overcome the low-cardinality restriction of lattice structures. Experimental results on synthetic and real datasets show that lattice-based algorithms outperform state-of-the-art Skyline techniques.

Chapter 7: Swarm Optimization Application to Molding Sand System in Foundries

In this chapter optimization of resin-bonded molding sand system is discussed. Six different case studies are considered by assigning different combination of weight fractions for multiple objective functions and corresponding desirability (Do) values are determined for DFA, GA, PSO and MOPSO-CD. The highest desirability value is considered as the optimum solution.

Chapter 8: Application of Computational Intelligence in Network Intrusion Detection – A Review

Network Intrusion detection (NID) suffers from several problems, such as false positives, operational issues in high dimensional data, and the difficulty of detecting unknown threats. Most of the problems with intrusion detection are caused by improper implementation of the network intrusion detection system (NIDS). The scope of this chapter encompasses the concept of NID and presents the core methods that use computational intelligence and cover Support vector machine, Hidden Naïve Bayes, Particle Swarm Optimization, Genetic Algorithm and Fuzzy logic techniques. The findings of this study highlight current research challenges and progress with focus on the promising new research directions.

Chapter 9: Performance Comparison of PSO and Hybrid PSO-GA in Hiding Fuzzy Sensitive Association Rules

It is possible to infer sensitive information from the published non sensitive data using association rule mining. An association rule is characterized as sensitive if its confidence is above disclosure threshold. This chapter proposes a system with aim to hide a set of sensitive association rules by perturbing the quantitative data that contains sensitive knowledge using PSO and Hybrid PSO-GA with minimum side effects like lost rules, ghost rules. The performance of PSO and Hybrid PSO-GA approach in effectively hiding Fuzzy association rule is also compared.

Chapter 10: Modeling Fish Population Dynamics for Sustainability and Resilience

Conservation of any living creature is very vital to maintain the balance of ecosystem. Fish is one of the most regularly consumed living creatures, and hence its conservation is essential for sustainable fish population to help maintain a balanced ecosystem. Developing a model on fish population dynamics is needed to achieve this objective. This chapter presents a system dynamics model that provides the scientific

tools for determining fish population, its growth, and harvesting. The model's sensitivity to changes in key parameters and initial values resulting from the changes in basic scenarios and boundary conditions were tested under different real-world changing conditions to maintain a sustainable fish population.

Chapter 11: Search for an Optimal Solution to Vague Traffic Problems Using the PSK Method

This chapter tries to categorize the transportation problem (TP) under four different environments and formulates the problem and utilizes the crisp numbers, triangular fuzzy numbers (TFNs) and trapezoidal fuzzy numbers (TrFNs) to solve the TP. A new method, namely, PSK (P. Senthil Kumar) method for finding a fuzzy optimal solution to fuzzy transportation problem (FTP) is proposed I this chapter. Practical usefulness of the PSK method over other existing methods is demonstrated and discussed.

Chapter 12: Design Patterns for Social Intelligent Agent Architectures Implementation

Multi-Agent Systems (MAS) architectures are popular for building open, distributed, and evolving software required by today's business IT applications such as eBusiness systems, web services or enterprise knowledge bases. Since the fundamental concepts of MAS are social and intentional rather than object, functional, or implementation-oriented, the design of MAS architectures can be eased by using social patterns. This chapter presents social patterns and focuses on a framework aimed to gain insight into these patterns.

Chapter 13: Agent-Based Software Engineering, Paradigm Shift, or Research Program Evolution

Information systems are deeply linked to human activities. Unfortunately, development methodologies have been traditionally inspired by programming concepts and not by organizational and human ones. This leads to ontological and semantic gaps between the systems and their environments. This chapter presents the adoption of agent orientation and Multi-Agent Systems (MAS) to reduce these gaps by offering modeling tools based on organizational concepts (actors, agents, goals, objectives, responsibilities, social dependencies, etc.) as fundamentals to conceive systems through all the development process.

Chapter 14: Application of Fuzzy Sets and Shadowed Sets in Predicting Time Series Data

In all existing works on fuzzy time series model, cluster with highest membership is used to form fuzzy logical relationships. However, the position of the element within the cluster is not considered. This chapter incorporates the idea of fuzzy discretization and shadowed set theory in defining intervals and uses the positional information of elements within a cluster in selection of rules for decision making. The objective is to show the effect of the elements, lying outside the core area on forecast.

Chapter 15: Fuzzy-DSS Human Health Risk Assessment Under Uncertain Environment

It is noticed that often model parameters, data, information are fouled with uncertainty due to lack of precision, deficiency in data, diminutive sample sizes, etc. In such environments, fuzzy set theory or Dempster-Shafer theory (DST) can be explored to represent this type of uncertainty. This chapter presents two algorithms to combine Dempster-Shafer structure (DSS) with generalized/normal fuzzy focal elements, generalized/normal fuzzy numbers within the same framework. Finally, human health risk assessment is carried out under these setting.

Chapter 16: Enhanced Complex Event Processing Framework for Geriatric Remote Healthcare

Geriatric Remote Health Monitoring System (GRHMS) uses WBAN (Wireless Body Area Network) which provides flexibility and mobility for the patients. GRHMS uses Complex Event Processing (CEP) to detect the abnormality in patient's health condition, formulate contexts based on spatiotemporal relations between vital parameters, learn rules dynamically and generate alerts in real time. Though, CEP is powerful in detecting abnormal events, its capability is limited due to uncertain incoming events, static rule base and scalability problem. Hence, this chapter addresses these challenges and proposes an enhanced CEP (eCEP) which encompasses augmented CEP (a-CEP), a statistical event refinement model to minimize the error due to uncertainty, Dynamic CEP (DCEP) to add and delete rules dynamically into the rule base and Scalable CEP (SCEP) to address scalability problem. Experimental results show that the proposed framework has better accuracy in decision making.

Chapter 17: CASPL – A Coevolution Analysis Platform for Software Product Lines

It is important to recognize that the change impact analysis and the evolution understanding in software product lines require greater focus than in single software. This chapter presents CASPL platform for co-evolution analysis in software product lines. The platform uses evolutionary trees that are mainly used in biology to analyze the co-evolution between applications. The major goal is to enhance the change understanding and to compare the history of changes in the applications of the family, at the aim of correcting divergences between them.

Chapter 18: Hybrid Term-Similarity-Based Clustering Approach and Its Applications

This chapter presents a method that first adopts ontology learning to generate ontologies via the hidden semantic patterns existing within complex terms. Then, it proposes service recommendation and selection approaches based on the proposed clustering approach. Experimental results show that developed term-similarity approach outperforms comparable existing clustering approaches. Further, empirical study of the prototyping recommendation and selection approaches have proved the effectiveness of proposed novel two approaches.

Chapter 19: Deep Model Framework for Ontology-Based Document Clustering

Although there is enormous amount of information available online, most of the documents are uncategorized. It is time consuming task for the users to browse through a large number of documents and search for information about specific topics. The ability of automatic clustering from uncategorized documents is important and has great potential to improve the efficiency of information seeking behaviors. To address this issue this chapter proposes a deep ontology based approach to document clustering. The obtained results are used to implement annotation rules and the information extraction capabilities of annotated framework are compared with and without using ontology.

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