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Next Generation Data Technologies for Collective Computational Intelligence

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Foreword

It is a great honor to me to write a foreword for this book on "Next Generation
Data Technologies for Collective Computational Intelligence". With the rapid
development of the Internet, the volume of data being created and digitized is
growing at an unprecedented rate, which if combined and analyzed through a
collective and computational intelligence manner will make a difference in the
organizational settings and their user communities.

The focus of this book is on next generation data technologies in support of col-
lective and computational intelligence. The book distinguish itself from others in
that it brings various next generation data technologies together to capture, inte-
grate, analyze, mine, annotate and visualize distributed data – made available from
various community users – in a meaningful and collaborative for the organization
manner.

This book offers a unique perspective on collective computational intelligence,
embracing both theory and strategies fundamentals such as data clustering, graph
partitioning, collaborative decision making, self-adaptive ant colony, swarm and
evolutionary agents. It also covers emerging and next generation technologies in
support of collective computational intelligence such as Web 2.0 enabled social
networks, semantic web for data annotation, knowledge representation and infer-
ence, data privacy and security, and enabling distributed and collaborative para-
digms such as P2P computing, grid computing, cloud computing due to the nature
that data is usually geographically dispersed and distributed in the Internet envi-
ronment.

This book will be of great interest and help to those who are broadly involved
in the domains of computer science, computer engineering, applied informatics,
business or management information systems. The reader group might include re-
searchers or senior graduates working in academia; academics, instructors and
senior students in colleges and universities, and software developers.

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Preface

Introduction

The use of collaborative decision and management support systems has evolved over the years through developments in distributed computational science in a manner, which provides applicable intelligence in decision-making. The rapid developments in networking and resource integration domains have resulted in the emergence and in some instances to the maturation of distributed and collaborative paradigms such as Web Services, P2P, Grid and Cloud computing, Data Mashups and Web 2.0. Recent implementations in these areas demonstrate the applicability of the aforementioned next generation technologies in a manner, which seems the panacea for solving very complex problems and grand challenges. A broad range of issues are currently being addressed; however, most of these developments are focused on developing the platforms and the communication and networking infrastructures for solving these very complex problems, which in most instances are well-known challenges. The enabling nature of these technologies allows us to visualize their collaborative and synergetic use in a less conventional manner, which are currently problem focused.

In this book, the focus is on the viewpoints of the organizational setting as well as on the user communities, which those organizations cater to. The book appreciates that in many real-world situations an understanding – using computational techniques – of the organization and the user community needs is a computational intelligence itself. Specifically, current Web and Web 2.0 implementations and future manifestations will store and continuously produce a vast amount of distributed data, which if combined and analyzed through a collective and computational intelligence manner using next generation data technologies will make a difference in the organizational settings and their user communities. Thus, the focus of this book is about the methods and technologies which bring various next generation data technologies together to capture, integrate, analyze, mine, annotate and visualize distributed data – made available from various community users – in a meaningful and collaborative for the organization manner.

In brief, the overall objective of this book is to encapsulate works incorporating various next generation distributed and other emergent collaborative data technologies for collective and computational intelligence, which are also applicable in various organizational settings. Thus, the book aims to cover in a comprehensive manner the combinatorial effort of utilizing and integrating various next generation collaborative and distributed data technologies for computational intelligence in various scenarios. The book also distinguishes itself by focusing on

assessing whether utilization and integration of next generation data technologies can assist in the identification of new opportunities, which may also be strategically fit for purpose.

Who Should Read the Book?

The content of the book offers state-of-the-art information and references for work undertaken in the challenging area of collective computational intelligence using emerging distributed computing paradigms. Thus, the book should be of particular interest for

Researchers and doctoral students working in the area of distributed data technologies, collective intelligence and computational intelligence, primarily as a reference publication. The book should be also a very useful reference for all researchers and doctoral students working in the broader fields of data technologies, distributed computing, collaborative technologies, agent intelligence, artificial intelligence and data mining.

Academics and students engaging in research informed teaching and/or learning in the above fields. The view here is that the book can serve as a good reference offering a solid understanding of the subject area.

Professionals including computing specialists, practitioners, managers and consultants who may be interested in identifying ways and thus, applying a number of well defined and/or applicable cutting edge techniques and processes within the domain area.

Book Organization and Overview

The book contains 22 self-contained chapters that were very carefully selected based on peer review by at least two expert and independent reviewers. The book is organized into four parts according to the thematic topic of each chapter.

Part I: Foundations and Principles

The part focuses on presenting state-of-the-art reviews on the foundations, principles, methods and techniques for collective and computational intelligence. In particular:

Chapter 1 illustrates the space-based computing paradigm aiming to support and facilitate software developers in their efforts to control complexity regarding concerns of interaction in software systems.

Chapter 2 presents a state-of-the-art review on ant colony optimization and data mining techniques and focus on their use for data classification and clustering. They briefly present related applications and examples and outline possible future trends of this promising collaborative use of techniques.

Chapter 3 offers a high-level introduction to the open semantic enterprise architecture. Because of its open nature it is free to adopt and extend, yet retains a root commonality to ensure all participating agents can agree on a common understanding without ambiguity, regardless of the underlying ontology or logic system used.

Chapter 4 discusses and evaluates techniques for automatically classifying and coordinating tags extracted from one or more folksonomies, with the aim of building collective tag intelligence, which can then be exploited to improve the conventional searching functionalities provided by tagging systems.

Chapter 5 provides an overview of the current landscape of computational models of trust and reputation, and it presents an experimental study case in the domain of social search, where it is shown how trust techniques can be applied to enhance the quality of social search engine predictions.

Part II: Advanced Models and Practices

The part focuses on presenting theoretical models and state-of-the-art practices on the area of collective and computational intelligence. These include but not limited to the application of formal concept analysis; classifiers and expression trees; swarm intelligence; channel prediction and message request; time costs and user interfaces. In particular:

Chapter 6 presents the formal concept analysis; a proposed data technology that complements collective intelligence such as that identified in the semantic web. The work demonstrates the discovery of these novel semantics through open source software development and visualizes data's inherent semantics.

Chapter 7 focuses on constructing high quality classifiers through applying collective computational techniques to the field of machine learning. Experiment results confirm gene expression programming and cellular evolutionary algorithms when applied to the field of machine learning, can offer an advantage that can be attributed to their collaborative and synergetic features.

Chapter 8 deals with the load-balancing problem by using a self-organizing approach. In this work, a generic architectural pattern has been presented, which allows the exchanging of different algorithms through plugging. Although it possesses self-organizing properties by itself, a significant contribution to self-organization is given by the application of swarm based algorithms, especially bee algorithms that are modified, adapted and applied for the first time in solving the load balancing problem.

Chapter 9 presents a new scheme for channel prediction in multicarrier frequency hopping spread spectrum system. The technique adaptively estimates the channel conditions and eliminates the need for the system to transmit a request message prior to transmit the packet data.

Chapter 10 discusses a theory on process for decision making under time stress, which is common among two or bilateral decision makers. The work also proposes a formula on strategic points for minimizing the cost of time for a certain process.

Chapter 11 presents a model for amplifying human intelligence, utilizing agents technology for task-oriented contexts. It uses domain ontology and task scripts for handling formal and semiformal knowledge bases, thereby helping to systematically explore the range of alternatives; interpret the problem and the context and finally, maintain awareness of the problem.

Part III: Advanced Applications

The part focuses on presenting cutting-edge applications with a specific focus on social networks; cloud computing; computer games and trust. In particular:

Chapter 12 investigates the use of a proposed architecture for continuous analytics for massively multi-play online games, to support the analytics part of the relevant social networks. The work presents the design and implementation of the platform, with a focus on the cloud-related benefits and challenges.

Chapter 13 studies feature extraction and pattern classification methods in two medical areas, Stabilometry and Electroencephalography. An adaptive fuzzy inference neural network has been applied by using a hybrid supervised/unsupervised clustering scheme while its final fuzzy rule base is optimized through competitive learning. The proposed system is based on a method for generating reference models from a set of time series.

Chapter 14 analyzes a service oriented architecture based next generation mobility management model. In this work, a practical case, e.g., a "mobile messaging" application showing how to apply the proposed approach is presented.

Chapter 15 creates a set of metrics for measuring entertainment in computer games. Specifically, the work here uses evolutionary algorithm to generate new and entertaining games using the proposed entertainment metrics as the fitness function. A human user survey and experiment using the controller learning ability is also included.

Chapter 16 investigates the problem of knowledge extraction from social media. Specifically, the work here presents three methods that use Flickr data to extract different types of knowledge namely, the community structure of tag-networks, the emerging trends and events in users tag activity, and the associations between image regions and tags in user tagged images.

Chapter 17 presents an anonymity model to protect privacy in large survey rating data. Extensive experiments on two real-life data sets show that the proposed slicing technique is fast and scalable with data size and much more efficient in terms of execution time and space overhead than the heuristic pair-wise method.

Part IV: Future Trends and Concepts

Finally, this part focuses on presenting future concepts and trends using either real or realistic scenarios. In particular:

Chapter 18 focuses on the next generation network and how underlying technologies should evolve and be used to help service providers remain competitive. Within this context, a migration strategy is proposed and explored enabling the development of a capable concept of how the structuring of networks must be changed, and in doing so taking into consideration the business needs of diverse service providers and network operators.

Chapter 19 discusses how next generation emerging technologies could help coin and prompt future direction of their fit-to-purpose use in various real-world scenarios including the proposed case of disaster management. Specifically, it reviews their possible combination with intelligence techniques for augmenting computational intelligence in a collective manner for the purpose of managing disasters.

Chapter 20 presents novel technologies for exploiting multiple layers of collective intelligence from user-contributed content. The exploitation of the emerging results is showcased using an emergency response and a consumers social group case studies.

Chapter 21 offers a review of mobile sensing technologies and computational methods for collective intelligence. Specifically, the work presented discusses the application of mobile sensing to understand collective mechanisms and phenomena in face-to-face networks at three different scales: organizations, communities and societies. Finally, the impact that these new sensing technologies may have on the understanding of societies, and how these insights can assist in the design of smarter cities and countries is discussed.

Chapter 22 outlines the key social drivers for dataveillance and illustrate some of the roles emerging technology plays in it. Within this context, the work presents a social ecological model of technology cooption. The proposed model provides a middle range theory for empirical analysis by identifying the key elements of technology cooption and their proposed links and the role of the stakeholders in such cooption.

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Part III: Advanced Applications

Part IV: Future Trends and Concepts