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Intelligent computing in large-scale systems

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Abstract

Intelligent computing in large-scale systems provides systematic methodologies and tools for building complex inferential systems, which are able to adapt, mine data sets, evolve, and act in a nimble manner within major distributed environments with diverse architectures featuring multiple cores, accelerators, and high-speed networks.

We believe that the papers presented in this special issue ought to serve as a reference for students, researchers, and industry practitioners interested in the evolving, interdisciplinary area of intelligent computing in large-scale systems. We very much hope that readers will find in this compendium new inspiration and ideas to enhance their own research.

1 Introduction

In recent years, we have been witnessing a growing interest in the design and implementation of intelligent models to address and solve complex issues in large-scale distributed systems. Such models and methodologies must provide effective reasoning and decision-making capabilities to a wide range of high-performance applications with different and, at times, conflicting requirements.

Based on classic computational intelligence, artificial intelligence, machine learning, and intelligent agents, *intelligent computing* is canonically defined as the application of advanced computing methods and techniques to address a complex problem in science or engineering. It is typically underpinned by key computational activities such as dynamic visualisation, knowledge representation, automated reasoning, and collaborative work.

On the other hand, large-scale systems such as grids, peer-to-peer and *ad hoc* networks, and clouds enable the aggregation and sharing of geographically distributed heterogeneous resources from different organisation with distinct owners, administrators, configurations, and policies. Moreover, the exponential growth of many- and multi-core processor architectures, embedded and programmable integrated circuits, hardware accelerators, and high-performance interconnections have equipped many organisations with affordable, large high-performance computing infrastructures.

However, the advent of such large-scale systems—where efficient intra- and inter-domain operation, low power consumption, and effective resource utilisation are key characteristics—requires to investigate novel methods and techniques to enable secure access to data and resources, efficient scheduling, self-adaptation, effective decentralisation, and self-organisation.

The concept of intelligent computing in large-scale systems therefore brings together results from both areas, making a positive impact on the development of new efficient data and information systems.

2 Contents of this issue

This special issue herewith presents original articles which report on the recent developments of models, solutions, and techniques related to all aspects of intelligent computing in large-scale distributed systems.

Context-awareness has emerged as a popular approach for the development of intelligent applications in pervasive large-scale environments, where personalisation is of crucial importance. Moore and Pham (2015) present rule strategies and conditional relationships in intelligent context-aware decision-support systems. They propose a global approach to profiling in distributed networks, which targets collective entities rather than particular individuals.

The second contribution of this special issue is by Irfan *et al.* (2015). Prepared by a diverse conglomeration of authors, this survey presents the state-of-the-art and recent developments in the complex analysis of text data in global social networks and portals. As the data is unstructured and fuzzy, the whole process is a challenging open-ended problem. The analysis is multi-level with a strong emphasis on the context and relationships among network users.

Byrski *et al.* (2015) present a summary of over a decade of research in multi-agent systems driven by various types of evolutionary strategies. Traditional methods for creating intelligent systems have privileged simple cognitive or computational processes. However, evolutionary computation can arguably model the dynamics of the topology and relationships among the components of such intelligent systems. This work discusses how this model of intelligence and adaptation to various environmental conditions can be effectively used to support major fully decentralised computational agent systems.

Monitoring of distributed systems can be carried out using multi-agent systems. Gateau *et al.* (2015) address the issue of relocation of functions (responsibilities) for agents under failing conditions in distributed systems monitoring. They validate their model using a weather station case study.

Secure authentication has long been considered a key characteristic in distributed networks. Conti *et al.* (2015) propose the use of embedded biometric sensors for enhancing the security of biometric user authentication in large-scale distributed systems. Their work has been evaluated using a number of standard databases.

Traditional search engines do not have capabilities to discern on the content retrieved from multiple sources of information. Buchanan *et al.* (2015) present a novel approach to aggregate heterogeneous, distributed repositories of information of fine art. By taking advantage of open museum interfaces and document repositories, this work enables the intelligent aggregation of large quantities of information scattered across the Internet, which can be curated and displayed in a structured way.

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