Special Issue: Big Data for Context-Aware Applications and Intelligent Environments

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Abstract

Disruptive paradigm shifts such as the Internet of Things (IoT) and Cyber-Physical Systems (CPS) are creating a wealth of streaming context information. Large-scale context-awareness combining IoT and Big Data drive the creation of smarter application ecosystems in diverse vertical domains, including smart health, finance, smart grids and cities, transportation, Industry 4.0, etc. This special issue addresses core topics on the design, the use and the evaluation of Big Data enabling technologies to build next-generation context-aware applications and computing systems for future intelligent environments.

Keywords: Context, Big Data, Intelligent Environments

1. Introduction

With emerging paradigms such as Big Data and Internet of Things (IoT) [1] and Cyber-Physical Systems [2], effectively tapping into growing amounts of disparate contextual information streams [3] remains a challenge, especially for large-scale application and service providers that need timely and relevant information to support adequate decision-making.

A deeper understanding on the strengths and weaknesses of state-of-the-art big data processing and analytics systems [4] is necessary to realize large-scale context-awareness and build Big Context architectures. In particular, the key question is how one can (a) identify relevant context information, (b) ascertain the quality of the context information, (c) extract semantic meaning from heterogeneous distributed information sources, and (d) do this data processing effectively for many concurrent context-aware applications with different requirements for adequate decision-making.

At the same time, fundamental research is necessary to understand how context information about these large-scale distributed data processing infrastructures itself can offer the intelligence to self-adapt the configuration of these systems to optimize resource usage, such as the networking, data storage, and computation required to process context data.

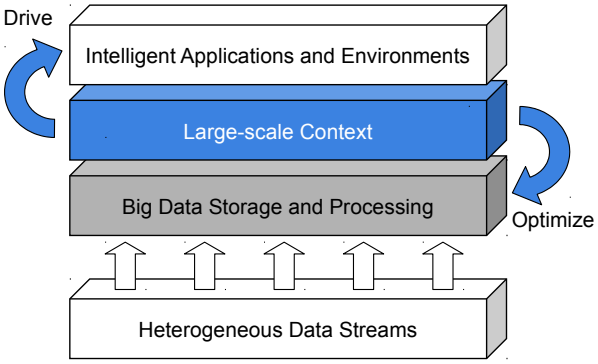

Figure 1: Big Data for context-aware intelligent environments

As depicted in Figure 1, Big Data storage and processing technologies can support the development of large-scale context-aware applications by effectively collecting, processing and reasoning upon large amounts of heterogeneous data in a distributed manner to drive large-scale intelligent environments. However, that same context information can be used to optimize, reconfigure and adapt the underlying Big Data platforms to ensure the needs of many concurrent context-aware applications are met in a timely manner.

The particular focus of this special issue is on Big Context solutions covering the modeling, designing, im-

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plementation, assessment and systematic evaluation of large-scale context-aware applications and intelligent Big Data systems.

2. Papers

This special issue covers 7 research papers targeting the broad range of research topics combining Big Data and context-aware applications or intelligent environments, including practical applications and case studies, application design methodologies, empirical evaluation of systems and metrics, underpinning theories, and more technical/scientific research topics. A high-level overview of the scope and contributions of these papers is provided below.

Ardagna et al. [5] argue that being able to assess the quality of heterogeneous data sources is a key concern for applications to successfully tap into big data. They also point out that due the large amounts of data, approximation is necessary.

In [6], Cantabella et al. present a use case on learning management systems that are gaining importance in higher education teaching models. They investigate the adoption of Big Data frameworks for the analysis of student behavior data generated by these learning management systems.

Curry et al. [7] specifically focus on a real-time linked dataspaces for Internet of Things enabled smart environments. They highlight how the use of linked dataspaces can enable analytics and decision support applications. They provide relevant experiences and lessons learned from 5 real-world smart environments.

In [8], Silva and Analide present a computational sustainability platform to manage contexts supported by principles of computational sustainability and the assurance of sustainable scenarios. Furthermore, they present an application case study based on social indicators and mood analysis to demonstrate the capabilities and some of the innovative functionalities of the platform.

Carneiro et al. [9] present a distributed system for data collection, processing and analysis. It particularly targets vocal emotion recognition with the goal to analyze the relationship between emotion, age, gender and human-computer interaction.

The use of complex networks and semantic technologies was explored by Horta et al. [10] for the analysis of scientific social networks. They were able to detect overlapping communities based on an algorithm that relies on bidirectional graphs. With the proposed approach, the authors were able to identify influential researchers.

Cheng et al. [11] specifically focus on cluster-based distributed graph processing frameworks, and argue that on the one hand, scalability remains a concern from an infrastructure investment point of view. On the other hand, they stipulate that single node based frameworks are cost-effective but have limited scalability. To address this dichotomy, they propose a pipeline-based task scheduling strategy, which they implemented in a distributed disk-based graph-processing framework, called DD-Graph. Their evaluation shows a high cost-effectiveness for experiments on very large graph datasets.

We hope the readers will enjoy the selection of papers in this special issue and that the topics addressed by the authors can inspire their own research.

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