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Algorithmic Aspects of Cloud Computing

5th International Symposium, ALGOCLOUD 2019
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Revised Selected Papers

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Preface

The International Symposium on Algorithmic Aspects of Cloud Computing (ALGOCLOUD) is an annual event that aims to tackle the diverse new topics in the emerging area of algorithmic aspects of computing and data management in the cloud.

The aim of the symposium is to bring together international researchers, students, and practitioners to present research activities and results on topics related to algorithmic, design, and development aspects of modern cloud-based systems.

As in previous years, paper submissions were solicited through an open call for papers. ALGOCLOUD welcomes submissions on all theoretical, design, and implementation aspects of modern cloud-based systems. We are particularly interested in novel algorithms in the context of cloud computing, cloud architectures, as well as experimental work that evaluates contemporary cloud approaches and pertinent applications. We also welcome demonstration manuscripts, which discuss successful elastic system developments, as well as experience/use-case articles and reviews. Contributions may span a wide range of algorithms for modeling, practices for constructing, and techniques for evaluating operations and services in a variety of systems, including but not limited to, virtualized infrastructures, cloud platforms, data centers, cloud-storage options, cloud data management, non-traditional key-value stores on the cloud, HPC architectures, etc.

Topics of interest addressed by this workshop include, but are not limited to:

- Analysis of algorithms and data structures
- Resource management and scheduling
- Data center and infrastructure management
- Privacy, security, and anonymization
- Cloud-based applications
- Virtualization and containers
- Performance models
- Cloud deployment tools and their analysis
- Novel programming models
- Storage management
- Fog and edge computing
- Economic models and pricing
- Energy and power management
- Big data and the cloud
- Network management and techniques
- Caching and load balancing

ALGOCLOUD 2019 took place on September 10, 2019, in Munich, Germany. It collocated and was part of ALGO 2019 (September 9–13, 2019), the major annual congress that combines the premier algorithmic conference European Symposium on Algorithms (ESA), and a number of other specialized symposiums and workshops, all

related to algorithms and their applications, making ALGO the major European event for researchers, students, and practitioners in algorithms.

There was a positive response to the ALGOCLOUD 2019 call for papers. The diverse nature of papers submitted demonstrated the vitality of the algorithmic aspects of cloud computing. All submissions went through a rigorous peer-review process and were reviewed by at least three Program Committee (PC) members. Following their recommendations, the PC chairs accepted seven original research papers in a wide variety of topics that were presented at the workshop. We would like to thank all PC members for their significant contribution in the review process.

The program of ALGOCLOUD 2019 was complemented with a highly interesting keynote, entitled "New Horizons in IoT Workflows Provisioning in Edge and Cloud Datacentres for Fast Data Analytics," which was delivered by Rajiv Ranjan (Newcastle University, UK), and an informative and well-thought-out tutorial entitled "Algorithms for a Smart Construction Environment," which was delivered by Vlado Stankovski (University of Ljubljana, Slovenia). We wish to express our sincere gratitude to both our esteemed invitees for their contributions.

Finally, we would like to thank all authors who submitted their research work to ALGOCLOUD and the Steering Committee for volunteering their time.

We hope that these proceedings will help researchers, students, and practitioners understand and be aware of state-of-the-art algorithmic aspects of cloud computing, and that they will stimulate further research in the domain of algorithmic approaches in cloud computing in general.

September 2019

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New Horizons in IoT Workflows Provisioning in Edge and Cloud Datacentres for Fast Data Analytics (Keynote Talk)

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Abstract. Supporting Internet of Things (IoT) workflow enactment/execution on a combination of computational resources at the network edge and at a datacentre remains a challenge. Increasing volumes of data being generated through smart phones and IoT devices (which can vary significantly in scope and capability), need to be processed in a timely manner [2]. Current practice involves using edge nodes (e.g. sensors or other low-capacity devices) as a means to acquire/collect data (i.e. as an "observation" mechanism). Subsequently, this data is transmitted to a datacentre/cloud for analysis/insight. Increasingly, the limitation with the use of a large-scale, centralised datacentre is being realised (such as speed of response for latency-sensitive applications), with the emergence of a number of paradigms to address this concern – such as fog computing, edge computing, Cloud-of-Things, etc. [1]. All of these propose the use of dedicated servers (with varying capacity and capability) within micro/nano datacentres at the network edge, to overcome latency constraints associated with moving data to a central facility and (lack of use of) increasing computational capability within edge devices. These paradigms also closely align with work in content distribution networks (e.g. from Akamai CDNs), which attempt to place data servers within one (or a small number of) hop-of-end users (currently 85% of users are supported in this way, with >175K Akamai servers).

A key objective of this keynote talk is to understand how such emerging paradigms can be used to enable cloud systems (supported through large scale computational facilities) to be "stretched" to the network edge, to enable data-driven IoT workflows to be enacted efficiently over such combined infrastructure. We propose the combined use of (varying) capability at the network edge (referred to as an Edge DataCentre (EDC)) with capability within a Cloud DataCentre (CDC). Collectively, IoT devices and edge resources, like gateways (Raspberry Pi 3), software-defined network systems (Huawei CloudEngine 6800), and smart phones equipped with sensors, constitute a new set of computing resources – and are potential components of an EDC [1, 3].
This keynote talk will have the following outline:

1. Overview of the research challenges involved with composing and orchestrating complex IoT workflows in cloud-edge continuum infrastructure.
2. Discuss two case studies in healthcare and smart cities domain to understand how data-driven workflows can be applied to create/compose next-generation IoT applications.

3. Discuss our experience with running the UK's largest IoT infrastructure, namely, the Urban Observatory (http://www.urbanobservatory.ac.uk/).

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