Third International Workshop on Big Data Driven Edge Cloud Services (BECS 2023)

3rd International Workshop on Big Data driven Edge Cloud Services (BECS 2023) – Preface

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Abstract. To harness the full potential of edge-cloud environments, it becomes imperative to establish novel paradigms and methodologies within the realm of web engineering. These advances aim to enhance the efficiency and dependability of data-driven, edge-cloud AI applications. The third edition of the international workshop on Big data-driven Edge Cloud Services (BECS 2023) served as a platform for scholars and practitioners to exchange insights and showcase their ongoing efforts in delivering efficient and scalable web services. These services cater to users' needs by leveraging extensive datasets in edge cloud environments.

Keywords: Edge cloud, Big data, Machine learning, AI applications.

1 Introduction

Due to the rapid proliferation of Web of Things (WoT) devices connecting to the cloud, we have witnessed an increase in latency and a reduction in the efficiency of gathering extensive data from these devices and delivering services through data analysis. To address this challenge, edge clouds have emerged as a novel computing infrastructure aimed at enhancing efficiency, scalability, and data privacy in delivering data-centric services.

An edge cloud comprises multiple tiers, including edges, fogs, and clouds, which facilitates the collection and processing of large-scale data in a localized fashion. This is made possible through the use of low-latency and dependable communication technologies such as 5G and beyond. To fully capitalize on the advantages offered by these edge-cloud environments, it is imperative to dynamically deploy and provide

required services while ensuring optimal utilization of distributed computing resources across the edge-cloud layers.

The third edition of the international workshop on Big data-driven Edge Cloud Services (BECS 2023) was organized to serve as a platform for scholars and practitioners to exchange insights and showcase their ongoing research on providing data-driven WoT services in edge cloud environments. The workshop was held in conjunction with the 23rd International Conference on Web Engineering (ICWE 2023), which was held in Alicante, Spain on June 6-9, 2023.

The topic area of the third BECS workshop includes the following: Web services in edge clouds; Web of Things in edge clouds; AI in edge computing (Edge AI); dependable and highly usable big data platforms; distributed data collection, analysis, and prediction; stream data processing in edge clouds; big knowledge graphs for distributed edge cloud environments; modeling and mashup of edge cloud services; micro-service architecture for edge cloud environments; and edge-cloud interaction and collaboration.

2 Keynote

During the BECS 2023 workshop, there was a keynote talk titled "Service governance on the edge, challenges ahead," delivered by Prof. Pablo Fernández from the University of Sevilla, Spain.

In his enlightening keynote, Prof. Fernández emphasized the significance of edge clouds as a pivotal environment capable of consolidating multiple domains. He underscored that the primary advantage of edge clouds lies in their capacity to foster a new generation of service chains, which can thrive and adapt in a continuous environment offering distinctive integration and customization prospects. Additionally, he delved into the challenges that emerge as service chains become more intricate, including issues related to elasticity, privacy, and capacity management. Prof. Fernández examined critical facets that must be tackled to harness these opportunities and effectively govern the development and operation of services within edge clouds.

3 Paper Presentations

At the BECS 2023 workshop, five full papers and two short papers were selected for presentation.

The first full paper, titled "A Novel Priority-based Scheduler for Asymmetric Multi-core Edge Computing" authored by Rupendra Hada, Abhishek Srivastava, addresses the scheduling challenge within the Linux operating system. The paper introduces a novel approach designed to function efficiently in both symmetric and asymmetric multi-core edge systems. The authors demonstrate that this proposed method can enhance task processing speeds by up to 16% for high-priority tasks.

In the second full paper presented at the workshop, authors Taewoo Kim, Minsu Jeon, Changha Lee, SeongHwan Kim, Fawaz Al-Hazemi, and Chan-Hyun Youn introduce an approach titled "SLO-aware DL Job Scheduling for Efficient FPGA-GPU

Edge Cloud Computing." This approach considers the diverse service-level objectives associated with deep learning tasks and periodically adjusts the accelerator configuration for deep learning processing while minimizing computational costs. They conducted experiments using a heterogeneous field-programmable gate array (FPGA)-GPU cluster to assess the performance of their proposed scheduler.

In the third full paper, titled "DESA: Decentralized Self-Adaptive Horizontal Autoscaling for Bursts of Load in Fog Computing," the authors, EunChan Park, Kyeong-Deok Baek, Eunho Cho, and In-Young Ko, address a crucial challenge in microservices orchestration: ensuring service elasticity when faced with unpredictable load bursts. They propose DESA, in which each microservice instance autonomously makes scaling decisions by either cloning or terminating itself through continuous self-monitoring. Experimental results demonstrate that DESA significantly reduces scaling reaction times in large-scale fog computing systems compared to the centralized approach.

In the fourth full paper, titled "TiME: Time-sensitive Multihop Data Transmission in Software-Defined Edge Networks for IoT," authored by Simran Gurung and Ayan Mondal, a software-defined edge architecture is proposed. Additionally, a game theoretic model is designed to optimize multi-hop data transmission. The authors employ a dynamic coalition game to determine the most efficient data transmission paths within edge networks for IoT. Furthermore, they evaluate and compare the performance of this proposed scheme with existing literature.

The fifth full paper presented at the workshop, authored by Changha Lee, Kyungchae Lee, Gyusang Cho, and Chan-Hyun Youn, introduces "DELCAS: Deep Reinforcement Learning based GPU CaaS Packet Scheduling for Enhancing QoE in 5G Multi-Access Edge Computing." DELCAS addresses a resource scheduling challenge arising from resource limitations that prevent offloading all users' packets to the edge server. To tackle this issue, the authors propose a deep reinforcement learning-based approach for GPU container as a service (CaaS) packet scheduling, aiming to enhance the quality of the AI experience.

Following the full paper presentations, two short papers were presented at the workshop. In the first short paper titled "Towards Integrating Digital Avatars in Urban Digital Twins on the Cloud-to-Thing Continuum," authors Lorenzo Toro-Gálvez, Rafael García-Luque, Javier Troya, Carlos Canal, and Ernesto Pimentel propose the integration of citizens through their digital avatars (DAs) into urban digital twins (UDTs). DAs allow for the exploitation of citizens' information, behavioral habits, and personal preferences while giving them full control over their data. The authors present an envisioned architecture that leverages the cloud-to-thing continuum to optimize available processing resources.

In the second short paper, titled "Exploring the Feasibility of ChatGPT for Enhancing the Quality of Ansible Scripts in Edge-Cloud Infrastructures through Code Recommendations," authors Sunjae Kwon, Sungu Lee, Taehyoun Kim, Duksan Ryu, and Jongmoon Baik investigate the feasibility of utilizing ChatGPT to improve the quality of Ansible scripts used for infrastructure as code (IaC). Through an evaluation of ChatGPT's code recommendation capability on various code revision cases from different Ansible project repositories, the authors confirm that ChatGPT can reasonably

recognize and understand Ansible scripts. They also discuss the importance of effective prompt engineering to achieve consistent code recommendation results.

4 Poster Presentations

Three posters were selected for showcasing at the BCD 2023 workshop. Here are the titles and authors of these posters:

- "An Analysis about Federated Learning in Low-Powerful Devices" presented by Daniel Flores-Martin, Francisco Díaz-Barrancas, Javier Berrocal, and Juan Manuel Murillo Rodríguez
- "IoT-NGIN ML as a Service (MLaaS), MLOPs for IoT" presented by Jorge Mira, Iván Moreno, Hervé Bardisbanian, and Jesús Gorroñogoitia
- "An Adaptive Spatial-Temporal GPU Scheduling in Edge Cloud Computing Environment" presented by Taewoo Kim, Tuan Manh Tao, Khac Tuyen Dinh, Minsu Jeon, Changha Lee, and Chan-Hyun Youn.

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