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Editorial

Special issue on "Uncertainty in Cloud Computing: Concepts, Challenges and Current Solutions"

This IJAR special issue on "Uncertainty in Cloud Computing: Concepts, Challenges and Current Solutions" is a follow-up to the first international workshop on Uncertainty in Cloud Computing (UCC'17), which was successfully held in Lyon, France, on August 29, 2017. This workshop collected researchers' insights and contributions on various cloud computing topics under uncertainty.

Although several researchers are active and publishing in cloud and service computing related conferences and journals, they lack forums that focus on uncertainty issues in cloud environments. This special issue groups the most recent contributions on uncertainty-aware cloud computing. Revised and extended versions of UCC'17 best papers, in addition to other external submissions, were evaluated and selected for publication according to IJAR guidelines. The common feature of these works is to provide a clear definition and modelling of uncertainty, imprecision and vagueness of cloud-related information.

The first paper of this special issue entitled *"An online sequential procurement mechanism under uncertain demands in multi-cloud environment"* by Jingti Han, Xiaohong Wu, Jian-Guo Liu [1] deals with resource procurement in multi-cloud settings under budget constraints and non-increasing marginal demand valuations. In this paper, the authors' aim is to design an individual rational mechanism for online procurement uncertain demands. The designed model takes advantage of a seller accepting-rule according to a density threshold. This rule is dynamically determined based on historical information. To provide a truthful and budget feasible resource procurement, Han et al. define three algorithms: (1) a static allocation algorithm with budget constraint, (2) a density threshold getting algorithm, and (3) an online accepting algorithm.

The second paper entitled *"The uncertain cloud: State of the art and research challenges"* by Haithem Mezni, Sabeur Aridhi, Allel Hadjali [2] aims to provide an understanding of uncertainty in cloud computing by surveying and classifying uncertainty-aware approaches according to the cloud services' lifecycle phases. The authors start by presenting the available definitions of "uncertainty in cloud computing", as well as the sources and impact of uncertainty on cloud computing operations. Then, the discussed contributions are arranged to uncertain resource provisioning, uncertain cloud service management, uncertain cloud service scheduling, uncertain cloud service selection and recommendation, uncertain service integration and composition, uncertain data management and analytics in cloud. Finally, major uncertainty issues are pointed such as the need for profiling cloud services and data, the need for uncertainty models for clouds, services and users, the need for uncertainty methods and theoretical algorithms, etc.

The third paper entitled *"A residue-based approach for resource provisioning by horizontal scaling across heterogeneous clouds"* by Kirthica S. and Rajeswari Sridhar [3] addresses the elasticity issues in inter-operating cloud environments by focusing on the uncertainty of resource provisioning levels and the uncertainty of the number of involved clouds (single or multiple clouds). As a solution to these challenges, the authors propose a residue-based technique for resource provisioning. A residue placer is designed by combining two existing strategies (Basic Placer and Equi Placer) of the cloud inter-operation toolkit. To satisfy the incoming requests, the residue placer dynamically splits a single request based on the resource availability on the previously queried clouds. Using this method, the authors' aim is to achieve horizontal scaling and to improve the transactions' success rate. Also, a greedy ranker algorithm is defined by the authors to rank clouds and improve the effectiveness of resource provisioning, enhancing then elasticity. In the experiments reported in this paper, indicated that the residue placer based approach outperformed the Basic Placer and Equi placer techniques. Nevertheless, the authors intend to improve their ranking algorithm and design a better technique to cope with the issues of horizontal scaling across multiple clouds.

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The fourth paper entitled *"Towards a fuzzy bigraphical multi agent system for cloud of clouds elasticity management"* by Rayene Moudjari, Zaidi Sahnoun, Faiza Belala [4] focuses on reducing the complexity of cloud elasticity management. To meet this goal at both inter-cloud and intra-cloud levels, the authors apply agent technology and propose MAS-C2EM: an agent-based system for Cloud of Clouds Elasticity Management. In this system, the cooperation between clouds is established based on a set of defined reaction rules and using fuzzy Pareto dominance. The authors also try to specify the multi-agent behavioral and structural aspects through the use of a semantic formalism called Bigraphical Reactive System (BRS). Finally, Moudjari et al. use the Model Checker BigMC tool to check the correctness of their approach and its ability to offer an elastic behavior. As a future extension to their proposed model, the authors plan to incorporate negotiation mechanisms in the context of BRS formalism.

The fifth paper entitled *"Towards an understanding of cloud services under uncertainty: A possibilistic approach"* by Asma Omri, Karim Benouaret, Djamal Benslimane, Mohamed Nazih Omri [5] tried to distinguish between traditional cloud services and uncertain cloud services that manipulate possibilistic data. To represent the uncertainty of cloud services' operations and their returned data, the authors introduce the notion of possibilistic cloud services and propose a possibilistic model for cloud services composition and invocation. This model adopts the notion of possibilistic database with provenance. After reviewing uncertainty in cloud and Web services, the authors propose a probability-aware composition algebra to compute the probabilities of the composition outputs based on conventional and possibilistic invocation (i.e., certain and possibilistic used inputs). An invocation model is also proposed by Omri et al. to allow for conventional invocation of cloud services using both certain input data, and possibilistic invocation using uncertain input data. As a future improvement to their works, the authors intend to focus on preference queries and address the problem of ranking the returned results.

In the last paper entitled *"AC-RRNS: Anti-collusion secured data sharing scheme for cloud storage"* by Andrei Tchernykh, Mikhail Babenkob, Nikolay Chervyakovb, Vanessa Miranda-Lópeza, Viktor Kuchukov et al. [6], the authors' goal is to reduce the denial of access to data and the risk uncertainty of data security breaches. For this purpose, they propose a configurable data storage scheme based on the computational secure and reliable RRNS secret sharing scheme. This scheme is based on an asymptotically perfect Asmuth-Bloom scheme with no knowledge. The authors identify three security threats (collusion, deliberate, accidental) and focus on the first one. To secure from cloud collusion, Tchernykh et al. combine the Asmuth-Bloom and Mignotte schemes. A new method is also defined to reduce the redundancy of data storage and to optimize the system behavior. Through their contributions, the authors prove that using secret keys in data storage schemes is more secure than with hidden moduli set in HORNS. As part of their future work, they will focus on assessing multi-parameter efficiency of software and hardware implementations.

We believe that this special issue is a good summary of current uncertainty issues in the context of cloud computing. As guest editors, we would like to thank the authors for their valuable contributions, and the reviewers for their rigorous reviews and efforts. Special thanks to the Editor-in-Chief, Prof. Thierry Denoeux for offering us the opportunity to edit this special issue.

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