Guest Editorial: Cloud Services Meet Big Data – Part II

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THIS is the second part of the Special Issue (SI) on Cloud Services Meet Big Data organized by us to solicit innovative and promising methods and techniques related closely to cloud services in the era of Big Data.

The second part of this SI includes seven regular papers that investigate the most challenging issues in the areas of IaaS (Infrastructure as a Service) design and operations, requirements engineering and knowledge engineering for cloud services development, and service search and discovery. We present a brief overview of the seven articles as follows.

The authors of the first two papers attempt to investigate a hot research topic in the field of Services Computing, IaaS design and operations, to design and construct more reliable infrastructures of cloud services for big data processing.

The first article, entitled "Data-Driven Auction Mechanism Design in IaaS Cloud Computing," by Chunxiao Jiang, Yan Chen, Qi Wang, and K.J. Ray Liu (an IEEE Fellow and an AAAS Fellow), proposes a stochastic matching algorithm with Markov Decision Process. Also, this article designs an efficient (EF), incentive compatible (IC), individual rational (IR) auction mechanism. Under two application scenarios of quality-sensitive services and quality-insensitive services, the authors experiment using the Google dataset, and the experimental results show that the proposed auction mechanism can achieve EF, IC, and IR properties simultaneously.

In the second article entitled "Hypervisor and Neighbors' Noise: Performance Degradation in Virtualized Environments," Seyed Hossein Nikounia and Siamak Mohammadi investigate performance degradation in a virtualized environment similar to IaaS clouds. The authors find that performance degradation in a virtualized environment could be much higher than those findings of previous studies. After exploring the causes of performance degradation, they provide some suggestions that motivate researchers to reduce performance degradation using hardware and software techniques.

When developing domain-specific cloud services, two common topics related closely to Software Engineering are requirements engineering and knowledge engineering. The second two articles attempt to tackle the challenging issues associated with the two topics from the perspectives of both service providers and users.

Irina Todoran Koitz and Martin Glinz introduce a new approach to requirements elicitation for cloud services in "A Fuzzy Galois Lattices Approach to Requirements Elicitation for Cloud Services." Considering that users are highly heterogeneous and geographically distributed, the authors utilize users' advanced search queries for services to infer requirements leading to new cloud solutions. To this end, they build fuzzy Galois lattices for cloud service providers to analyze market needs and trends, as well as optimal solutions, using the idea of mass customization.

In the second article on knowledge engineering for software development, "Linking Issue Tracker with Q&A Sites for Knowledge Sharing across Communities," Huaimin Wang (a fellow of the CCF (China Computer Federation)), Tao Wang, Gang Yin, and Cheng Yang investigate the problem of knowledge sharing across different open-source communities. They propose an automatic approach by integrating semantic similarity with temporal locality between the communities of Android and Stack Overflow. Besides, their extensive experiments indicate that the proposed approach archives a significant improvement in recommendation accuracy.

The last three articles fall within the scope of one of the essential parts of the Services Computing field, and they attempt to address a few challenging problems of service search and discovery in untrusted cloud environments or social networks.

In "Privacy-Preserving Top-k Spatial Keyword Queries in Untrusted Cloud Environments," Sen Su, Yiping Teng, Xiang Cheng, Ke Xiao, Guoliang Li, and Junliang Chen (a member of the Chinese Academy of Sciences and a member of the Chinese Academy of Engineering) investigate the problem of privacy-preserving top-k spatial keyword queries. They design a novel privacy-preserving top-k spatial keyword query scheme based on an encrypted tree index. To improve query performance on large-scale spatio-textual data, the authors further propose a keyword-based secure pruning method. Besides, the experimental results on real datasets demonstrate the high efficiency and good scalability of the proposed scheme.

Hanhua Chen and Hai Jin (a CCF Fellow) attempt to tackle the problem of keyword searching in large-scale social networks in their article entitled "Efficient Keyword Searching in Large-Scale Social Network Service." The authors propose a novel protocol called summary index to support keyword

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searching. In particular, the summary index representations are memory efficient, and the summary dissemination for index updating is communication efficient. Besides, the experimental results show that the proposed scheme significantly outperforms the given existing schemes for OSN searching regarding inter-sever traffic.

The last article of the second part of this SI, entitled "Efficient and Exact Query of Large Process Model Repositories in Cloud Workflow Systems," formulates the problem of business process (BP) model searching in large-scale cloud workflow repositories. Hua Huang, Rong Peng, and Zaiwen Feng propose an improved two-stage query approach based on the graph (data) structure. More specifically, a composite task index is used to retrieve candidate BP models in the filtering stage, while a novel subgraph isomorphism test based on task code is proposed to refine the candidate set of BP models in the verification stage. Besides, the experimental results show that the proposed approach can significantly improve the query efficiency and reduce the query response time.

Eventually, we expect that the fascinating research contributions of the articles in this SI would offer potential insights into the further research of Services Computing and spark broad discussion in the emerging area of cloud services when meeting big data.

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Schahram Dustdar is full professor of Computer Science heading the Distributed Systems Group at the TU Wien, Austria. From 2004-2010 he was also honorary professor of Information Systems at the Department of Computing Science at the University of Groningen (RuG), The Netherlands. From December 2016 to January 2017 he was a visiting professor at the University of Sevilla, Spain and from January to June 2017 he was a visiting professor at UC Berkeley, USA. He is co-editor-in-chief of the new *ACM Transactions on the Internet of Things* as well as editor-in-chief of *Computing* (Springer). He is an associate editor of *IEEE Transactions on Services Computing*, *IEEE Transactions on Cloud Computing*, *ACM Transactions on the Web*, and *ACM Transactions on Internet Technology*, as well as on the editorial board of *IEEE Internet Computing* and *IEEE Computer*. He is the recipient of the ACM Distinguished Scientist award (2009), the IBM Faculty Award (2012), an elected member of the Academia Europaea: The Academy of Europe, where he is chairman of the Informatics Section, as well as an IEEE Fellow (2016).

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