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Editorial

Special issue on dependability in parallel and distributed systems and applications

Computers are now available anytime, anywhere, by dif-ferent means, and are distributed unobtrusively throughout everyday environments in which physical objects/artifacts em-bedded with invisible computers are sensible and networked locally and globally. “omputer systems” are often interpreted broadly that include system architectures, operating systems, parallel and distributed systems, and computer networks. Such systems open tremendous opportunities to provide numerous novel services/applications in both real world and cyber spaces. Nowadays, achieving high confidence in them is becoming harder as systems are becoming more complex.

Particularly, majority of parallel and distributed systems today depend greatly on the use of commercial off-the-shelf technology for software and/or hardware for purposes of cost and time to market. Many approaches to fault-tolerant and reliable systems treated as “dependable systems” assume complete control and understanding of both hardware and software system components. Even if complete understanding of the components were possible, an undependable situation may appear as components become outdated and are replaced or updated many times during the production and deployment life of many critical systems. Therefore, evaluating depend-ability properties of parallel and distributed systems today is becoming an important concern for engineers, practitioners, academics, and organizations. Future systems need to close the dependability gap in face of challenges encountered in different circumstances.

For example, a certain circumstance can be related to data-driven dependability. Textual or numeric data analysis of large datasets and log files generated under real workload conditions by distributed systems, including network systems, big data systems, and cloud systems plays major roles for dependability evaluation. Data analysis is crucial in a variety of tasks, such as measuring availability, reliability, sustainability, and safety of a system, characterizing failures, gaining insights into the progression of security attacks, and understanding countermeasures.

Another circumstance can be related to the dependability in cyber-physical systems and applications, including smart grid, healthcare, telemetry monitoring, robotic, RFID, crowd-sensing, aerospace, and industrial applications. The development of cyber-physical systems and ensuring their de-pendability requires appropriate theories, tools, hardware, and frameworks to allow designers, engineers, and practitioners to deal with large system sizes and complex interactions between cyber and physical system components. However, there are many inherent challenges in ensuring the dependability.

Further circumstance can be related to dependability issues in cloud systems and applications. Cloud system research and development has shown a great deal of promise as a scalable and cost-effective system model for supporting scientic applications. In fact, cloud systems facilitate elastic computing capacity, virtualized resources, and pay-as-you-go billing models. However, dependability in terms of information privacy and security is becoming a serious issue for the cloud systems, due to its open environment with very limited user-side control. There is also a great challenge for Big Data. Particularly, there are two important issues for cloud-based systems: how to protect Big Data and use Big Data analytic technique to enhance security of a whole system.

This *Special Issue* on Dependability in Parallel and Dis-tributed Systems and Applications is motivated by the com-pelling challenges and requirements identified above, and aims to compile research that fundamentally addresses them. *Information Science* journal has recognized this important and timely concerns in this special issue. It has attempted to provide an opportune forum for presenting recent advances, original ideas, techniques, algorithms, and the like belonging to dependability issues in parallel and distributed systems and applications. We received an overwhelming response from the research community. The selected papers contribute impor-tant advances towards dependability issues. The contributions focus on several topics, which can be grouped under five different and distinct categories, viz., cloud virtualization and privacy protection, dependable big data mining systems, de-pendability in network system and applications, dependability issue in cyber-physical systems, and parallel and distributed system issues. Contributions that include applications depend-ability come from healthcare, smart grid, mobile user on the railway, etc.

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The first category (cloud virtualization and privacy protec-tion) includes four papers. High-availability of virtual machines is of significant importance for a cloud computing environment, because cloud services may be compromised due to the system maintenance, malicious attacks, and hard-ware and software failures. Challenges arise when attempting to use virtual machine (VM) snapshot methods that suffer from performance issues such as long downtime and I/O performance degradation during a live snapshot. To address such issues, Jianxin et al. proposed an VM snapshot sys-tem, iROW (improved Redirect-on-Write). This system em-ploys techniques, including a bitmap-based light-weight index method is designed to reduce the query cost. Cheng et al. proposed a lightweight live memory forensic framework based on hardware virtualization. It can build a virtualization envi-ronment on-the-fly. Zhang et al. proposed a technique called match-then-decrypt to ensure attribute privacy protection and fast decryption for outsourced data security in mobile cloud computing. The last paper in this category is about dynamic access policy in cloud-based personal health record (PHR) systems, which is proposed by Liu et al. They developed a dynamic policy updating approach by utilizing the proxy re-encryption technique.

The second category (dependable big data mining systems) includes four papers. Chen et al. developed Reality-Mining, which is a prediction algorithm proposed for predict disease dynamics based on mobile big data. MapReduce offers an ease-of-use programming paradigm for processing big data sets. A challenging issue is that resource availability has a great impact on MapReduce applications running over the Internet. Tang et al. addressed this issue through an availability and network-aware MapReduce framework over the Internet. Under such a MapReduce framework, omission failures repre-sent an important source of problems. Memishi et al. addressed the omission failures in MapReduce systems. Finally, Rashid et al. proposed a data mining framework called frequent sensor patterns (RFSPs), based on behavioral patterns mining from sensor data using hadoop platform.

The third category (dependability in network systems and applications) includes three papers. Social influence analysis in mobile social networks has become an important technology in modern information and service industries. Challenges appear when to measure social influence of one user on other users in a mobile social network. In this regard, Peng et al. focused on a mechanism to quantitatively measure social influence in mobile social networks. Wang et al. conducted real-world experiments on high-speed trains to investigate the quality of 3G connections performance in mobile networks. They proposed a fog computing structure to create an intermediate layer between the end users and the 3G infrastructure so that reliability to unstable connections in the networks can be achievable, especially for the high-speed end mobile users (e.g., those on trains and buses). In the last paper of this category, Esposito et al. presented a solution to resolve high degree of reliability obtained at the expenses of severe perfor-mance instability issue by effectively tuning the redundancy degree. As a result, it was possible to tolerate losses affecting the multicast communications without an excessive workload imposed over the network.

The fourth category (dependability issue in cyber-physical systems) includes three papers. First, Rahman et al. presented *AnonPri*, which is a secure anonymous private authentica-tion protocol for RFID systems. *AnonPri* offers high-speed authentication in large-scale systems and overcomes an im-portant limitation (the level of privacy decreases as more and more tags are compromised) with the state-of-the-art RFID authentications methods (group-based and tree based). Huda et al. presented an approach to defend unknown security attack on cyber-physical systems by semi-supervised approach that automatically integrates knowledge about unknown malware coming from already available and cheap unlabeled data. Finally, Shahriar et al. proposed a secure and private protocol for demand-response bidding in smart grids. This protocol is significant as it achieves certain security and privacy goals to protect user data from adversarial attacks in smart grids. The final category (parallel and distributed system issues) includes two papers. Zhang et al. developed a bi-objective workflow scheduling of the energy consumption and reliability in heterogeneous computing systems. Yang et al. dealt with a problem factorization of popular public key cryptographic algorithm, RSA. Focusing on speeding up the factorization process of RSA, they proposed a parallel block Lanczos algorithm over GF(2) for integer factorization.

Editing this special issue has been a valuable experience to us. Although the selected papers contribute and address only a limited set of issues related to the dependability in parallel and distributed systems and applications, the papers clearly demonstrate how a lack of dependability in systems and applications can influence overall system and application performance. We would like to thank all the researchers who had responded to the call and acknowledge the tremendous efforts that went into their submissions. We would like to thank Professor W. Pedrycz, the Editor-in-Chief of Information Sciences for his support. Finally, we thank the INS SI support personnel, including Prof. Paul Wang, Zhu Jacqueline, and Sandacoumar Sudhakar.

Guest Editors

Md Zakirul Alam Bhuiyan
Department of Computer and Information Science Fordham University, USA

Sy-Yen Kuo
College of Electrical Engineering and Computer Science National Taiwan University, Taiwan

Jie Wu
Department of Computer and Information Sciences Temple University, USA

E-mail addresses: mbhuiyan3@fordham.edu, zakirulalam@gmail.com (M.Z.A. Bhuiyan), sykuo@ntu.edu.tw (S.-Y. Kuo), jiewu@temple.edu (J. Wu)