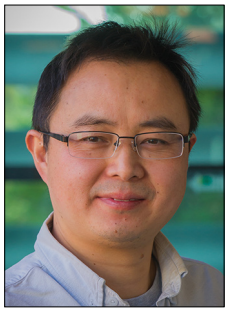
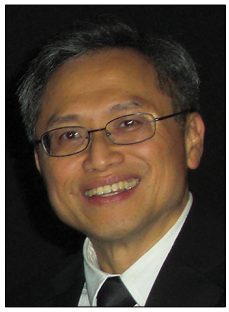
Big Data for Networking


Song Guo


Shui Yu


Jie Li


Nirwan Ansari

Big data analytics has shown great potential in optimizing operations, making decisions, spotting business trends, preventing threats, and capitalizing on new sources of revenues in various fields such as manufacturing, healthcare, finance, insurance, and retail. The management of various networks has become inefficient and difficult because of their high complexities and interdependencies. Big data, in forms of device logs, software logs, media content, and sensed data, provide rich information and facilitate a fundamentally different and novel approach to explore, design, and develop reliable and scalable networks. This Special Issue covers the most recent research results that address challenges of big data for networking. We received 45 submissions, and ultimately nine high quality papers, organized into two groups, have been selected for inclusion in this Special Issue.

Four articles included in the first group apply various data mining techniques for network management and control. The article "A Dynamic Bandwidth Allocation Algorithm in Mobile Networks with Big Data of Users and Networks," authored by Bo Fan, Supeng Leng, and Kun Yang, utilizes the collected big network data to cluster users by analyzing their closeness, both geographical and social, such that users in the same cluster share a wireless channel for downloading contents from the base station. It not only improves the data rate of cluster users, but also saves the resource of the base station. The second article, "A Hyperbolic Space Analytics Framework for Big Network Data and Their Applications" by Eleni Stai, Vasileios Karyotis, and Symeon Papavassiliou, studies big data analytics over hyperbolic space that exhibits exponential scaling features and demonstrates how this approach could lead to more efficient and scalable problem solving in network design analysis, network resource allocation optimization, and network economics marketing. To provide online data mining, the article "Deep Semantics Inspection over Big Network Data at Wire Speed" by Chengchen Hu, Hao Li, Yuming Jiang, Yu Cheng, and Poul Heegaard, reveals the semantics behind big network data on the fly by proposing deep semantics inspection. It is designed to capture, analyze, and present user behavior at wire speed by gathering the unstructured data into a unified framework. Finally, the article "Data Mining Algorithms for Communication Networks Control: Concepts, Survey and Guidelines" by Mauro De Sanctis, Igor Bisio, and Giuseppe Araniti, provides a comprehensive survey of recent research results on applying data mining for communication network control along with guidelines for future applications.

Four articles included in the second group propose a new big data processing model, architecture, and framework to harness the power of big data for networking. The first article, "A Tensor-Based Big Data Model for QoS Improvement in Software Defined Networks" by Liwei Kuang, Laurence T. Yang, Xiaokang Wang, Puming Wang, and Yaliang Zhao, develops a tensor-based big data model that formalizes networking functions and routing recommendations in the data plane and the control plane, respectively, of software defined networks (SDN). The next article, "Mobile Big Data Fault-Tolerant Processing for eHealth Networks," by Kun Wang, Yun Shao, Lei Shu, Yan Zhang, and Chunsheng Zhu, proposes a three-layer architecture for mobile eHealth networks. It adopts the reduced variable neighborhood search technique for rapid data analysis such that only valuable data will be reported to healthcare providers. The third article, "Big Data Driven Optimization for Mobile Networks toward 5G", by Kan Zheng, Zhe Yang, Kuan Zhang, Periklis Chatzimisios, Wei Xiang, and Kai Yang, describes a framework that integrates big data analytics and mobile network optimization with the objective of improving the user quality of experience and the performance of mobile networks toward 5G. To provide mobile social users with a satisfactory quality of experience, another article, "Big Data in Mobile

Social Networks: A QoE-Oriented Framework" by Zhou Su, Qichao Xu, and Qifan Qi, proposes a framework to deliver mobile big data over content centric based mobile social networks.

The last article, "When Big Data Meets Software Defined Networking: SDN for Big Data and Big Data for SDN", by Laizhong Cui, F. Richard Yu, and Qiao Yan, studies the issues overlapped in both groups. The authors showed that big data analytics could benefit SDN in traffic engineering, cross-layer design, and mitigating security attacks. They also explore the good features of SDN as an infrastructure that can greatly facilitate big data acquisition, transmission, storage, and processing. The joint design of big data and SDN seems to be a promising solution for big data networking.

In conclusion, the articles presented in this Special Issue demonstrate the breadth and diversity of research in the field of big data for networking. We wish to thank the authors and the reviewers for their hard work in helping us assemble this Special Issue. We would also like to express our sincere gratitude to the current Editor-in-Chief, Professor Nei Kato, and the past Editor-in-Chief, Professor Sherman Shen, for providing this opportunity and tremendous guidance throughout the process.

Biographies

SONG GUO [M'02, SM'11] is a full professor at the University of Aizu, Japan. His research interests are mainly in the areas of networking, cloud computing, and big data. He has published more than 300 papers in refereed journals and conferences in these areas. He has served as associate editor of IEEE TPDS, IEEE TETC, etc. He has served on organizing committee and program committee for numerous international conferences. He is a senior member of ACM and an IEEE Communications Society Distinguished Lecturer.

SHUI YU is a senior lecturer at the School of IT, Deakin University, Australia. His research interests include security and privacy, big data, and mathematical modelling. He has published two monographs and edited two books and more than 100 technical papers. Dr. Yu pioneered the research field of networking for big data in 2013. He is currently serving on the editorial boards of IEEE TPDS, IEEE CST, and *IEEE Access*. He is a senior member of IEEE.

JIE LI is a professor on the Faculty of Engineering, Information and Systems, University of Tsukuba, Japan. His research interests are in mobile distributed multimedia computing and networking, big data and cloud computing, OS, modelling and performance evaluation of information systems. He is a senior member of IEEE and ACM and a member of IPSJ (Information Processing Society of Japan). He is the chair of the IEEE Technical Sub-Committee on Big Data (TSCBD), ComSoc.

NIRWAN ANSARI [S'78, M'83, SM'94, F'09] is a distinguished professor of ECE at NJIT. He has (co-)authored more than 450 technical publications, more than one third in widely cited refereed journals/magazines. He was also granted more than 25 U.S. patents. Some of his recognitions include IEEE Fellow, several Excellence in Teaching Awards, best paper awards, an NCE Excellence in Research Award, ComSoc AHSNTC Outstanding Service Recognition Award, New Jersey Inventors Hall of Fame Inventor of the Year Award, Thomas Alva Edison Patent Award, Purdue University Outstanding Electrical & Computer Engineer Award, and designation as an IEEE Communications Society Distinguished Lecturer.