2020 IEEE 13th International Conference on Cloud Computing (CLOUD 2020)

Beijing, China 18 – 24 October 2020



IEEE Catalog Number: CFP20CLO-POD **ISBN:**

978-1-7281-8781-5

Copyright © 2020 by the Institute of Electrical and Electronics Engineers, Inc. All Rights Reserved

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

IEEE Catalog Number:	CFP20CLO-POD
ISBN (Print-On-Demand):	978-1-7281-8781-5
ISBN (Online):	978-1-7281-8780-8
ISSN:	2159-6182

Additional Copies of This Publication Are Available From:

Curran Associates, Inc 57 Morehouse Lane Red Hook, NY 12571 USA Phone: (845) 758-0400 Fax: (845) 758-2633 E-mail: curran@proceedings.com Web: www.proceedings.com



2020 IEEE 13th International Conference on Cloud Computing (CLOUD) CLOUD 2020

Table of Contents

Message from the SERVICES 2020 Steering Committee Chair xvi
Message from the SERVICES 2020 Symposia General Chair xvii
Welcome Message from Congress 2020 General Chairs xviii
Message from the SERVICES 2020 Program Chairs in Chief xx
Message from the SERVICES 2020 Technical Committee Chair on Services Computing of IEEE
Computer Society xxi
Welcome Message from the SERVICES 2020 Women in Services Computing Symposium Chair xxii
Symposium on Women in Services Computing Program xxiii
SERVICES 2020 Steering Committee xxv
SERVICES 2020 Program Committee xxix
Message from the CLOUD 2020 Chairs xxx
CLOUD 2020 Organizing Committee xxxi

Session CLD 1: WIP – Cloud Applications I

Anomaly Detection in Cloud Components .1.... Mohammad Saiful Islam (Ryerson University) and Andriy Miranskyy (Ryerson University)

The Research on Agricultural Product Price Forecasting Service Based on Combination Model .4. Guang Zheng (Henan Agricultural University), Hui Zhang (Henan Agricultural University), Jingjing Han (Henan Agricultural University), Chenhui Zhuang (Henan Agricultural University), and Lei Xi (Henan Agricultural University)

Recursive LSTM with Shift Embedding for Online User-Item Interaction Prediction .1.0..... Chengyu Yin (Nanjing University of Aeronautics and Astronautics), Senzhang Wang (Nanjing University of Aeronautics and Astronautics), and Hao Miao (Nanjing University of Aeronautics and Astronautics)

Designing Knowledge Plane to Optimize Leaf and Spine Data Center <u>1.3</u>..... *Mujahid Sultan (Ryerson University), Dodi Imbuido (Aytra Inc., Canada), Kam Patel (Aytra Inc., Canada), James MacDonald (Aytra Inc., Canada), and Kumar Ratnam (Aytra Inc., Canada)*

Session CLD 2: WIP – Cloud and Edge Management

LambDP: Data Processing Framework for Terminal Applications in IoTs Services 1	6
Liqing Zhao (State Key Laboratory of Networking and Switching Technology, Beijing University of Posts and Telecommunications), Bo Cheng (State Key Laboratory of Networking and Switching Technology, Beijing University of Posts and Telecommunications), and Junliang Chen (State Key Laboratory of Networking and Switching Technology, Beijing University of Posts and Telecommunications)	
Adaptive Control Channel Traffic Shaping for Virtualized SDN in Clouds	22
TensorExpress: In-Network Communication Scheduling for Distributed Deep Learning	25
Offloading Deadline-Aware Task in Edge Computing	28

Session CLD 3: WIP – Orchestration and Data Analysis

Analysis of SQL Workloads on an Enterprise Datalake	31
Container Orchestration on HPC Systems	34
Deep Neural Architecture for Geospatial Trajectory Completion over Occupancy Gridmap 3 Asif Nawaz (Nanjing University of Aeronautics and Astronautics), Zhiqiu Huang (Nanjing University of Aeronautics and Astronautics), Senzhang Wang (Nanjing University of Aeronautics and Astronautics), and Amara Naseer (Nanjing University of Aeronautics and Astronautics)	;7
Constrained Energy-Cost-Aware Workflow Scheduling for Cloud Environment	0

Session CLD 5: Invited I

Be Your Neighbor's Miner: Building Trust in Ledger Content via Reciprocally Useful Work .5.3.... Lara Mauri (Università degli Studi di Milano), Ernesto Damiani (Khalifa University), and Stelvio Cimato (Università degli Studi di Milano)

The Million Dollar Handshake: Secure and Attested Communications in the Cloud .63..... Nikolaos Chalkiadakis (FORTH-ICS), Dimitris Deyannis (FORTH-ICS), Dimitris Karnikis (FORTH-ICS), Giorgos Vasiliadis (FORTH-ICS), and Sotiris Ioannidis (Technical University of Crete)

Session CLD 6: Invited II

ViCLOUD: Measuring Vagueness in Cloud Service Privacy Policies and Terms of Services .7.1..... Anantaa Kotal (University of Maryland, Baltimore County), Karuna Joshi (University of Maryland, Baltimore County), and Anupam Joshi (University of Maryland, Baltimore County)

- VR Design and Display System of Ceramic Products Based on Cloud Service Platform .80...... Wentao Zhang (Jingdezhen Ceramic Institute), Hua Huang (Jingdezhen Ceramic Institute), Meikang Qiu (Jingdezhen Ceramic Institute), and Qiangfei Ma (Jingdezhen Ceramic Institute)
- Cloud Governance .86..... Bhavani Thuraisingham (The University of Texas at Dallas)
- Service Management in the Edge Cloud for Stream Processing of IoT Data .91...... Hachem Moussa (UTD), I-Ling Yen (UTD), and Farokh Bastani (UTD)

Session CLD 7: Service Prediction and Optimization

Service Load Prediction Based on User Knowledge Level Evolution for Software Development Knowledge Base .9.9... owledge Base 99. Ming Yi (School of Software, Shandong University, China), Yuliang Shi (School of Software, Shandong University, China; Dareway Software Co., Ltd, Jinan, China), and Kun Zhang (School of Software, Shandong University, China; Dareway Software Co., Ltd, Jinan, China) Scalable Graph Convolutional Network Based Link Prediction on a Distributed Graph Database Server .1.07..... Anuradha Karunarathna (University of Moratuwa, Sri Lanka), Dinika Senarath (University of Moratuwa, Sri Lanka), Shalika Madhushanki (University of Moratuwa, Sri Lanka), Chinthaka Weerakkody (University of Moratuwa, Sri Lanka), Miyuru Dayarathna (WSO2, Inc. USA; University of Moratuwa, Sri Lanka), Sanath Jayasena (University of Moratuwa, Sri Lanka), and Toyotaro Suzumura (IBM T.J. Watson Research Center, USA; MIT-IBM Watson AI Lab, USA; Barcelona Supercomputing Center, Spain) Resource and Job Execution Context-Aware Hadoop Configuration Tuning <u>116</u>..... Xinhe Wang (Shandong University, China), Jianlin Zhang (Shandong University, China; Dareway Software Co., Ltd, China), and Yuliang Shi (Shandong University, China; Dareway Software Co., Ltd, China)

Session CLD 8: Cloud Applications II

Toward Efficient Indoor Positioning for Cloud Services in SIoT <u>124</u> Nan Jiang (East China Jiaotong University, China), Guangjie Dong (East China Jiaotong University, China), Yiying Hu (East China Jiaotong University, China), Li Gao (East China Jiaotong University, China), and Jing Chen (East China Jiaotong University, China)
 VMatch: A Matching Theory Based VDC Reconfiguration Strategy .1.33 Anurag Satpathy (National Institute of Technology Rourkela, India), Manmath Narayan Sahoo (National Institute of Technology Rourkela, India), Lucky Behera (National Institute of Technology Rourkela, India), Chittaranjan Swain (National Institute of Technology Rourkela, India), and Ashutosh Mishra (National Institute of Technology Rourkela, India)
Deep Unsupervised Workload Sequence Anomaly Detection with Fusion of Spatial and Temporal Features in the Cloud 1.41 Mengqing Wang (Henan Normal University, China), Zhihua Zhang (Henan Normal University, China), Jialei Liu (Anyang Normal University, China), Li Duan (Beijing Key Laboratory of Security and Privacy in Intelligent Transportation, Beijing Jiaotong University), and Chunhong Liu (Henan Normal University, China; Engineering Lab of Intelligence Business & Internet of Things, China)

Session CLD 9: Cloud Performance Evaluation

Serverless Elastic Exploration of Unbalanced Algorithms <u>149</u> Gerard París (Universitat Rovira i Virgili), Pedro García-López (Universitat Rovira i Virgili/IBM Watson Research), and Marc Sánchez-Artigas (Universitat Rovira i Virgili)
DEAR: Distributed Evaluation of Alerting Rules .1.58 Mathias Mormul (University of Stuttgart), Pascal Hirmer (University of Stuttgart), Christoph Stach (University of Stuttgart), and Bernhard Mitschang (University of Stuttgart)
A Content-Wise Data Placement Policy for Improving the Performance of MapReduce-Based

Video Processing Applications in Cloud Computing .1.6.6..... Eihab SaatiAlsoruji (Taibah University, Medina, Saudi Arabia)

Session CLD 10: Edge Caching & Computation Offloading

Feifei Chen (Deakin University), Jingwen Zhou (Deakin University), Xiaoyu Xia (Deakin University), Hai Jin (Huazhong University of Science and Technology), and Qiang He (Swinburne University of Technology) Proactive Data Caching and Replacement in the Edge Computing Environment .1.93..... Ying Liu (Northeastern Unversity), Ao Zhang (Northeastern University), Xiaoyu Xia (Deakin Universit), Feifei Chen (Deakin University), Lei Ye (Zhejiang University of Technology), Bin Zhang (Northeastern University), and Qiang He (Swinburne University of Technolog)

Session CLD 11: Cloud Applications III

MYSTIKO: Cloud-Mediated, Private, Federated Gradient Descent .20.1..... K. R. Jayaram (IBM Research AI), Archit Verma (IBM Research AI), Ashish Verma (IBM Research AI), Gegi Thomas (IBM Research AI), and Colin Sutcher-Shepard (Rensselaer Polytechnic Institute (RPI) and IBM Research AI)

PONCHE: Personalized and Context-Aware Vehicle Rerouting Service .21.1..... Lucas Zanco Ladeira (University of Campinas), Allan M. de Souza (University of Campinas), Thiago H. Silva (Univ. Tecnologica Federal do Parana), Richard W. Pazzi (Ontario Tech University), and Leandro A. Villas (University of Campinas)

Auto-Generation of Domain-Specific Systems: Cloud-Hosted DevOps for Business Users .219.. Saurabh Sinha (IBM T.J. Watson Research Center), Tara Astigarraga (IBM T.J. Watson Research Center), Richard Hull (New York University), Nerla Jean-Louis (University of Illinois at Urbana-Champaign), Vugranam Sreedhar (IBM Cloud), Hao Chen (IBM Research - China), Lian Xue Hu (IBM Research - China), Federico Carpi (IBM Argentina), Juan Ariel Brusco Cannata (IBM Argentina), and William Loach (IBM United Kingdom)

Session CLD 12: Cloud Management I

Auto-Scaling Cloud-Based Memory-Intensive Applications .229. Joe Novak (University of Utah), Sneha Kasera (University of Utah), and Ryan Stutsman (University of Utah)

ImageJockey: A Framework for Container Performance Engineering .238..... Takeshi Yoshimura (IBM Research - Tokyo), Rina Nakazawa (IBM Research - Tokyo), and Tatsuhiro Chiba (IBM Research - Tokyo)

Flexible and Efficient Partial Migration of Split-Memory VMs .248..... Takahiro Kashiwagi (Kyushu Institute of Technology) and Kenichi Kourai (Kyushu Institute of Technology)

Session CLD 13: SDN and NFV

A Hierarchical Control Plane Framework for Integrated SDN-SFC Management in Multi-tenant Cloud Data Centers .258..... Lakshmi J (Indian Institute of Science) and Lakshmi B S (Indian Institute of Science)

Resource Optimization and Delay-Aware Virtual Network Function Placement for Mapping SFC Requests in NFV-Enabled Networks .267.
Yi Yue (Beijing University of Posts and Telecommunications), Bo Cheng (Beijing University of Posts and Telecommunications), and Xuan Liu (Beijing University of Posts and Telecommunications)
QoS Control Method Based on SDN for Mobile Cloud Service .275 Bingcheng Jiang (Guilin University of Electronic Technology), Qian He (Guilin University of Electronic Technology), Xiongying Li (Guilin University of Electronic Technology), and Huan Huang (Guilin University of Electronic Technology)
Session CLD 14: Serverless Computing and Containers
On the Use of Containers in High Performance Computing Environments, 284

Subil Abraham (Virginia Tech), Arnab K. Paul (Virginia Tech), Redwan Ibne Seraj Khan (Virginia Tech), and Ali R. Butt (Virginia Tech)
Lambdata: Optimizing Serverless Computing by Making Data Intents Explicit .294

Yang Tang (Columbia University) and Junfeng Yang (Columbia University) Serverless Computing: Behind the Scenes of Major Platforms <u>.304</u>..... Daniel Kelly (National University of Ireland Galway), Frank Glavin (National University of Ireland Galway), and Enda Barrett (National

University of Ireland Galway)

Session CLD 15: Microservices and Containers

Realizing a Composable Enterprise Microservices Fabric with Al-Accelerated Material Discovery API Services .313 Rong N. Chang (IBM Research), Kumar Bhaskaran (IBM Research), Prasenjit Dey (IBM Research), Hsiang Han Hsu (IBM Research), Seiji Takeda (IBM Research), and Toshiyuki Hama (IBM Research)
 Sledge : Towards Efficient Live Migration of Docker Containers .321 Bo Xu (Huazhong University of Science and Technology, China), Song Wu (Huazhong University of Science and Technology, China), Jiang Xiao (Huazhong University of Science and Technology, China), Hai Jin (Huazhong University of Science and Technology, China), Yingxi Zhang (State Key Laboratory of Intelligent Manufacturing System Technology, China), Guoqiang Shi (State Key Laboratory of Intelligent Manufacturing System Technology, China), Tingyu Lin (State Key Laboratory of Intelligent Manufacturing System Technology, China), Jia Rao (The University of Texas at Arlington, USA), Li Yi (Alibaba Cloud Computing Co. Ltd., China), and Jizhong Jiang (Alibaba Cloud Computing Co. Ltd., China)
RITA: Efficient Memory Allocation Scheme for Containerized ParallelSystems to Improve Data Processing Latency .329 Danlin Jia (Northeastern University), Mahsa Bayati (Northeastern University), Ron Lee (Samsung Semiconductor), and Ningfang Mi (Northeastern University)

Session CLD 16: Edge Application I

Session CLD 17: Edge Application II

(University of Texas at Arlington), and Shaolei Ren (University of California, Riverside)

CFP: A Cross-Layer Recommender System with Fine-Grained Preloading for Short Video Streaming at Network Edge .380..... Dezhi Ran (Peking University), Yuanxing Zhang (Peking University), Ye

Yuan (Peking University), and Kaigui Bian (Peking University)

Session CLD 18: Network and Storage Optimization

A Lightweight SOA-Based Network Slicing Creation System <u>389</u> Meng Wang (Beijing University of Posts and Telecommunications), Bo Cheng (Beijing University of Posts and Telecommunications), and Junliang Chen (Beijing University of Posts and Telecommunications)

PCHA: A Fast Packet Classification Algorithm for IPv6 Based on Hash and AVL Tree .39.7...... Yu-yan Zhang (Beijing University of Posts and Telecommunications), Xing-xing Chen (Beijing University of Posts and Telecommunications), and Xu Zhang (Beijing University of Posts and Telecommunications) An Efficient Database Backup and Recovery Scheme Using Write-Ahead Logging .405..... Hwajung Kim (Seoul National University), Heon Young Yeom (Seoul National University), and Yongseok Son (Chung-Ang University)

Session CLD 19: Deep Learning and Federated Learning

The Design and Implementation of a Scalable Deep Learning Benchmarking Platform .41.4..... Cheng Li (University of Illinois Urbana-Champaign), Abdul Dakkak (University of Illinois Urbana-Champaign), Jinjun Xiong (IBM T. J. Watson Research Center), and Wen-mei Hwu (University of Illinois Urbana-Champaign)

FedMax: Enabling a Highly-Efficient Federated Learning Framework .426..... Haohang Xu (Shanghai Jiao Tong University), Jin Li (Shanghai Jiao Tong University), Hongkai Xiong (Shanghai Jiao Tong University), and Hui Lu (Binghamton University)

Variable Batch Size across Layers for Efficient Prediction on CNNs .435.... Anamitra Roy Choudhury (IBM Research - India), Saurabh Goyal (IBM Research - India), Yogish Sabharwal (IBM Research - India), and Ashish Verma (IBM T. J. Watson Research Center)

Session CLD 20: Cloud Management and Governance

Towards Tracking Data Flows in Cloud Architectures .445. Immanuel Kunz (Fraunhofer AISEC), Valentina Casola (University of Naples Federico II), Angelika Schneider (Fraunhofer AISEC), Christian Banse (Fraunhofer AISEC), and Julian Schütte (Fraunhofer AISEC)

Enforcing Corporate Governance's Internal Controls and Audit in the Cloud .453..... Sabrina De Capitani di Vimercati (Università degli Studi di Milano), Sara Foresti (Università degli Studi di Milano), Stefano Paraboschi (Università degli Studi di Bergamo), and Pierangela Samarati (Università degli Studi di Milano)

Maximizing Reliability of Data-Intensive Workflow Systems with Active Fault Tolerance Schemes in Cloud .462.....

Weiling Li (Dongguan University of Technology), Xiaoning Sun (Chongqing University), Kewen Liao (Swinburne University of Technology), Yunni Xia (Chongqing University), Feifei Chen (Deakin University), and Qiang He (Swinburne University of Technology)

Session CLD 21: SHORT – Cloud Modelling I

Modelling VM Latent Characteristics and Predicting Application Performance Using Semi-supervised Non-negative Matrix Factorization .4.7.0..... Yuhui Lin (University of St Andrews, UK), Adam Barker (University of St Andrews, UK), and John Thomson (University of St Andrews, UK) Proactive Container Auto-Scaling for Cloud Native Machine Learning Services .475..... David Buchaca (Barcelona Supercomputing Center), Josep Lluis Berral (Barcelona Supercomputing Center), Chen Wang (IBM Research), and Alaa Youssef (IBM Research)

What-If QoS Prediction of Cloud-Hosted Web Services via Domain Adaptation in Evolutionary Scenarios .480..... *Tianqi Sun (Shanghai University of Engineering Science) and Jianpeng Hu (Shanghai University of Engineering Science)*

Session CLD 22: Cloud Performance and Maintenance

Scheduling Physical Machine Maintenance on Qualified Clouds: What if Migration is not Allowed? 485. Long Wang (IBM Cloud), Harigovind Ramasamy (Amazon), and Richard Harper (IBM Research, Retired)

RAD: Detecting Performance Anomalies in Cloud-Based Web Services .<u>493</u>..... Joydeep Mukherjee (York University, Toronto), Alexandru Baluta (York University, Toronto), Marin Litoiu (York University, Toronto), and Diwakar Krishnamurthy (University of Calgary, Canada)

Session CLD 23: SHORT – Cloud Modelling II

A Noise-Aware Asymmetric Spectral Regularization Collective Matrix Factorization Algorithm for Recommender System in Cloud Services <u>502</u>..... Juntao Han (Henan University of Economics and Law) and Yong Pan (Henan University of Economics and Law)

Phase Aware Performance Modeling for Cloud Applications <u>.507</u>..... Arnamoy Bhattacharyya (University of Toronto), Cristiana Amza (University of Toronto), and Eyal de Lara (University of Toronto)

Cloud Resource Provisioning and Bottleneck Eliminating for Meshed Web Systems .5.12...... Yamin Lei (Nanjing University of Science and Technology, China), Zhicheng Cai (Nanjing University of Science and Technology, China), Hang Wu (Nanjing University of Science and Technology, China), and Rajkumar Buyya (The University of Melbourne, Australia)

Session CLD 24: SHORT – Cloud Management III

VM Migration for Secure Out-of-Band Remote Management with Nested Virtualization .5.1.7.... Tomoya Unoki (Kyushu Institute of Technology) and Kenichi Kourai (Kyushu Institute of Technology)

A Prediction Based Replica Selection Strategy for Reducing Tail Latency in Distributed Systems .522.....

Santa Maria Shithil (Bangladesh University of Engineering and Technology (BUET)) and Muhammad Abdullah Adnan (Bangladesh University of Engineering and Technology (BUET)) Energy Efficient Decentralized Geographical Load Balancing via Dynamic Deferral of

Workload .527.... Zeenat Islam (Bangladesh University of Engineering and Technology), Md Moniruzzaman (Bangladesh University of Engineering and Technology), and Muhammad Abdullah Adnan (Bangladesh University of Engineering and Technology)

Session CLD 25: SHORT- Cloud Applications IV

Evaluating Concurrent Executions of Multiple Function-as-a-Service Runtimes with MicroVM .532 Jungae Park (Kookmin University), Hyunjune Kim (Kookmin University), and Kyungyong Lee (Kookmin University)

A Control System for Managing the Flexibility in BPMN Models of Cloud Service Workflows .5.37 Imen Ben Fraj (Tunis Higher Business School (ESCT)), Yousra BenDaly Hlaoui (Mathematical, Physical and Natural Sciences of Tunis (FST)), and Leila Ben Ayed (National School of Computer Science (ENSI))

Spark-Tuner: An Elastic Auto-Tuner for Apache Spark Streaming .544..... MohammadReza HoseinyFarahabady (The University of Sydney), Javid Taheri (Karlstad University, Sweden), Albert Y. Zomaya (The University of Sydney), and Zahir Tari (RMIT University, School of Science, Australia)

Session CLD 26: Cloud Security

Forward Secure Public Key Encryption with Keyword Search for Cloud-Assisted IoT .549...... Hyeongseob Kim (Korea University), Changhee Hahn (Korea University), and Junbeom Hur (Korea University)

Robustness Analysis of Triangle Relations Attack in Social Recommender Systems .5.5.7...... Jia Wang (Chongqing University), Min Gao (Chongqing University), Zongwei Wang (Chongqing University), Runsheng Wang (Chongqing University), and Junhao Wen (Chongqing University)

LSH-Based Collaborative Recommendation Method with Privacy-Preservation .5.6..... Jiangmin Xu (Nanjing University of Science and Technology), Xuansong Li (Nanjing University of Science and Technology), Hao Wang (Norwegian University of Science and Technology), Hong-Ning Dai (Macau University of Science and Technology), and Shunmei Meng (Nanjing University of Science and Technology)

Session CLD 27: Edge-Cloud Collaboration

GMAS: A Geo-Aware MAS-Based Workflow Allocation Approach on Hybrid-Edge-Cloud Environment

Meng Niu (Beijing University of Posts and Telecommunications), Bo Cheng (Beijing University of Posts and Telecommunications), and Jun-Liang Chen (Beijing University of Posts and Telecommunications) Multi-request Scheduling and Collaborative Service Processing for DASH-Video Optimization in Cloud-Edge Network .582.

Xuan Zhao (Nanjing University), Song Zhang (Nanjing University), and Wanchun Dou (Nanjing University)

JANUS: Benchmarking Commercial and Open-Source Cloud and Edge Platforms for Object and Anomaly Detection Workloads .590.....

Karthick Shankar (Purdue University), Pengcheng Wang (Purdue University), Ran Xu (Purdue University), Ashraf Mahgoub (Purdue University), and Somali Chaterji (Purdue University)

Session CLD 28: Cloud Task Scheduling

RSDS: Getting System Call Whitelist for Container through Dynamic and Static Analysis .600.... Xuhao Wang (Peking University), Qingni Shen (Peking University), Wu Luo (Peking University), and Pengfei Wu (Peking University)

Skedulix: Hybrid Cloud Scheduling for Cost-Efficient Execution of Serverless Applications .609. Anirban Das (Rensselaer Polytechnic Institute), Andrew Leaf (Rensselaer Polytechnic Institute), Carlos A. Varela (Rensselaer Polytechnic Institute), and Stacy Patterson (Rensselaer Polytechnic Institute)

TOPOSCH: Latency-Aware Scheduling Based on Critical Path Analysis on Shared YARN Clusters 619

Chunming Hu (Beihang University), Jianyong Zhu (Beihang University), Renyu Yang (University of Leeds), Hao Peng (Beihang University), Tianyu Wo (Beihang University), Shiqing Xue (Beihang University), Xiaoqiang Yu (Beihang University), Jie Xu (University of Leeds), and Rajiv Ranjan (Newcastle University)

Author Index 629