

IEEE DSC

IEEE International Conference on Data Science in Cyberspace

5th IEEE International Conference on
Data Science in Cyberspace

(IEEE DSC 2020)

27-29 July 2020

Hong Kong, China



THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學

Program at a glance

Session	27 July (Monday)	28 July (Tuesday)	29 July (Wednesday)
AM Session 0		Opening	
AM Session 1	BDMC / VAAL / MSNFA	Keynote 1 Keynote 2	Keynote 4 Keynote 5
Break	Break	Break	Break
AM Session 2	BDMC / VAAL	S1 / S2	S5 / S6
Lunch	Lunch	Lunch	Lunch
PM Session 1	MDATA / BDBA / MUST	Keynote 3	Keynote 6
Break	Break	Break	Break
PM Session 2	MDATA	S3 / S4	S7 / S8

Workshop Program Day 1: 27 July (Monday)

Time	Zoom: icdsc1	Zoom: icdsc2	Zoom: icdsc3
9:00-10:40	Big Data Mining for Cyberspace	Vulnerability Analysis and Adversarial Learning	Multi-Source Network Fusion and Analysis
10:40-10:50	Break		
10:50-12:30	Big Data Mining for Cyberspace	Vulnerability Analysis and Adversarial Learning	
12:30-14:00	Lunch		
14:00-15:40	Multi-dimensional Data Association and inTelligent Analysis	Big Data and Business Analytics	Mobile Ubiquitous Systems and Technologies
15:40-15:50	Break		
15:50-17:30	Multi-dimensional Data Association and inTelligent Analysis		

Conference Program Day 2: 28 July (Tuesday)

Time	Zoom: icdsc1	Zoom: icdsc2
8:45-9:00	Opening	
9:00-10:00	Keynote 1: Network Representation Learning: Opportunities and Open Challenges Speaker: Ling Liu Chair: Tamer Ozsu	
10:00-11:00	Keynote 2: Practicing the Art of Data Science Speaker: Jian Pei Chair: Zhiguo Gong	
11:00-11:10	Break	
11:10-12:30	S1. Data Intensive Applications	S2. Social Networks
12:30-14:00	Lunch	
14:00-15:00	Keynote 3: DHA-based Knowledge Graph Construction Speaker: Lei Chen Chair: Marc Spaniol	
15:00-15:15	Break	
15:15-17:10	S3. Cyberspace Security, Privacy and Trust I	S4. Knowledge Discovery

Conference Program Day 3: 29 July (Wednesday)

Time	Zoom: icdsc1	Zoom: icdsc2
9:00-10:00	Keynote 4: Data Cleaning: An Machine Learning Problem in Need of Data Systems Help Speaker: Ihab F. Ilyas Kaldas Chair: Hui Xiong	
10:00-11:00	Keynote 5: Defining Cyberspace Security based on the Perspective of Three Dimensions and Nine Spaces Speaker: Bingxin Fang Chair: Qing Li	
11:00-11:10	Break	
11:10-12:30	S5. Cyberspace Security, Privacy and Trust II	S6. Machine Learning
12:30-14:00	Lunch	
14:00-15:00	Keynote 6: Cognitive Graph for Understanding, Reasoning, and Decision Speaker: Jie Tang Chair: Yi Cai	
15:00-15:15	Break	
15:15-17:10	S7. Sentiment Analysis in Cyberspace	S8. Data Mining and IR

Keynotes

Keynote 1 (Tuesday 9:00 – 10:00)

Speaker: Ling Liu, School of Computer Science, Georgia Institute of Technology

Topic: Network Representation Learning: Opportunities and Open Challenges

Abstract

Mining information networks have traditionally relied on observable features, such as node and link properties as well as user-defined statistical features extracted from complex networks, such as node degree, traversal path. With the recent success of deep neural networks, a wide variety of deep neural network models have been proposed, which can automatically learn to encode network structure into low-dimensional embeddings, using techniques based on deep learning and nonlinear dimensionality reduction. These network representation learning (NRL) approaches replace the need for manual feature engineering with automated learning of latent features of network representation, and have led to state-of-the-art results in network-based tasks, such as node classification, node clustering, and link prediction. In this keynote, I will describe the recent advancements in NRL, including network embedding, graph neural networks, including the methods to embed individual nodes as well as algorithms to embed entire (sub)graphs. Most existing models learn node embeddings through flat information propagation across the edges or traversal paths within each node's local neighborhood. I will share our experience with employing NRL for Bitcoin transaction forecasting, and a general framework for graph neural networks to learn node representations, which can generate node embeddings that preserve the global structure of the original graphs at different levels of the graph hierarchy.

Biography



Ling Liu is a Professor in the School of Computer Science at Georgia Institute of Technology. She directs the research programs in the Distributed Data Intensive Systems Lab (DiSL), examining various aspects of large scale big data-powered artificial intelligence (AI) systems, and machine learning (ML) algorithms and analytics, including performance, availability, privacy, security and trust. Prof. Liu is an elected IEEE Fellow, a recipient of IEEE Computer Society Technical Achievement Award (2012), and a recipient of the best paper award from numerous top venues, including IEEE ICDCS, WWW, ACM/IEEE CCGrid, IEEE Cloud, IEEE ICWS. Prof. Liu served on editorial board of over a dozen international journals, including the editor in chief of IEEE Transactions on Service Computing (2013-2016) and currently, the editor in chief of ACM Transactions on Internet Computing (TOIT). Prof. Liu is a frequent keynote speaker in top-tier venues in Big Data, AI and ML systems and applications, Cloud Computing, Services Computing, Privacy, Security and Trust. Her current research is primarily supported by USA National Science Foundation under CISE programs and IBM.

Keynote 2 (Tuesday 10:00 – 11:00)

Speaker: Jian Pei, School of Computing Science, Simon Fraser University

Topic: Practicing the Art of Data Science

Abstract

Data science embraces interdisciplinary methodologies and tools, such as those in statistics, artificial intelligence/machine learning, data management, algorithms, and computation. The art of practicing data science to empower innovative applications, however, remains an art due to many factors beyond technology, such as sophistication of application scenarios, business demands, and the central role of human being in the loop. In this talk, I will share with the audience some experience and lessons I learned from my practice of data science research and development. First, I will illustrate the core value of building domain-oriented, end-to-end data science solutions that can help people gain new interpretable domain knowledge. Second, using network embedding as an example, I will demonstrate that the nature of data science practice is to connect challenges in vertical applications with general scientific principles and tools. If time permits, I will also discuss some future directions, particularly about data strategies for enterprises and organizations on data as assets, privacy, fairness, accountability, and transparency.

Biography



Jian Pei's professional interest is to facilitate efficient, fair, and sustainable usage of data for social, commercial and ecological good. Through inventing, implementing and deploying a series of data mining principles and methods, he produced remarkable values to academia and industry. His algorithms have been adopted by industry, open source toolkits and textbooks. His publications have been cited over 97,500 times. He is also an active and productive volunteer for professional community services, such as chairing ACM SIGKDD and the steering committee of WSDM, running many premier academic conferences in his areas, and being editor-in-chief or associate editor for the flagship journals in his fields. He is recognized as a fellow of the Royal Society of Canada (i.e., the national academy of Canada), a fellow of the Canadian Academy of Canada, a fellow of ACM, and a fellow of IEEE. He received a series of prestigious awards, such as the ACM SIGKDD Innovation Award, the ACM SIGKDD Service Award, and the IEEE ICDM Research Award. Currently he is a full professor at Simon Fraser University.

Keynote 3 (Tuesday 14:00 – 15:00)

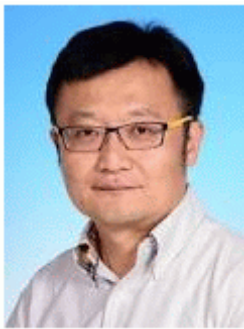
Speaker: Lei Chen, Department of Computer Science, Hong Kong University of Science and Technology

Topic: DHA-based Knowledge Graph Construction

Abstract

Recently, AI has become quite popular and attractive, not only to the academia but also to the industry. The successful stories of AI on various of applications raise significant public interests on AI. Meanwhile, human intelligence is turning out to be more sophisticated, and Big Data technology is everywhere to improve our life quality. In this talk, I will discuss about DHA, a new computing paradigm, which combines big Data, Human intelligence, and AI (DHA). Specifically, I will first briefly explain the motivation of the DHA. Then I will present challenges, after that, I will present a case study to build a knowledge graph with the help of DHA.

Biography



Lei Chen has BS degree in computer science and engineering from Tianjin University, Tianjin, China, MA degree from Asian Institute of Technology, Bangkok, Thailand, and PhD in computer science from the University of Waterloo, Canada. He is a professor in the Department of Computer Science and Engineering, Hong Kong University of Science and Technology (HKUST). Currently, Prof. Chen serves as the director of Big Data Institute at HKUST, director of Master of Science on Big Data Technology and director of HKUST MOE/MSRA Information

Technology Key Laboratory. Prof. Chen's research interests include human-powered machine learning, crowdsourcing, Blockchain, graph data analysis, probabilistic and uncertain databases and time series and multimedia databases. Prof. Chen got the SIGMOD Test-of-Time Award in 2015. The system developed by Prof. Chen's team won the excellent demonstration award in VLDB 2014. Prof. Chen has served as VLDB 2019 PC Co-chair. Currently, Prof. Chen serves as Editor-in-Chief of VLDB Journal, associate editor-in-chief of IEEE Transaction on Data and Knowledge Engineering. He is an IEEE Fellow, ACM Distinguished Member and an executive member of the VLDB endowment.

Keynote 4 (Wednesday 9:00 – 10:00)

Speaker: Ihab F. Ilyas, Cheriton School of Computer Science, University of Waterloo

Topic: Data Cleaning: An Machine Learning Problem in Need of Data Systems Help

Abstract

Data scientists spend big chunk of their time preparing, cleaning, and transforming raw data before getting the chance to feed this data to their well-crafted models. Despite the efforts to build robust predication and classification models, data errors still the main reason for having low quality results. This massive labor-intensive exercises to clean data remain the main impediment to automatic end-to-end AI pipeline for data science.

In this talk, I focus on data cleaning as an inference problem that can be automated by leveraging the great advancements in AI and ML in the last few years. I will start with a background describing the evolution of data cleaning efforts, and I will describe The HoloClean framework, a machine learning framework for data profiling and cleaning (error detection and repair). The framework has multiple successful deployments with cleaning census data, and pilots with commercial enterprises to boost the quality of source (training) data before feeding them to downstream analytics.

HoloClean builds two main probabilistic models: a data generation model (describing how data was intended to look like); and a realization model (describing how errors might be introduced to the intended clean data). The framework uses few-shot learning, data augmentation, and weak supervision to learn the parameters of these models, and use them to predict both error and their possible repairs.

While the idea of using statistical inference to model the joint data distribution of the underlying data is not new, the problem has been always: (1) how to scale a model with millions of data cells (corresponding to random variables); and (2) how to get enough training data to learn the complex models that are capable of accurately predicting the anomalies and the repairs. HoloClean tackles exactly these two problems.

Biography



Ihab Ilyas is a professor in the Cheriton School of Computer Science and the NSERC-Thomson Reuters Research Chair on data quality at the University of Waterloo. His main research focuses on the areas of big data and database systems, with special interest in data quality and integration, managing uncertain data, machine learning for data curation, and information extraction. Ihab is a co-founder of Tamr, a startup focusing on large-scale data integration, and he is also the co-founder of inductiv (now part of Apple), a Waterloo-based startup on

using AI for structured data cleaning. He is a recipient of the Ontario Early Researcher Award, a Cheriton Faculty Fellowship, an NSERC Discovery Accelerator Award, and a Google Faculty Award, and he is an ACM Distinguished Scientist. Ihab is an elected member of the VLDB Endowment board of trustees, elected SIGMOD vice chair. He holds a PhD in computer science from Purdue University, West Lafayette.

Keynote 5 (Wednesday 10:00 – 11:00)

Speaker: Bingxin Fang, Chinese Academy of Engineering and Guangzhou University

Topic: Defining Cyberspace Security based on the Perspective of Three Dimensions and Nine Spaces

Abstract

TBD

Biography



Professor Fang Bingxin is academician of Chinese Academy of Engineering, Former President of Beijing University of Posts and Telecommunications, principal representative of the 11th National People's Congress, the expert of information network and information security. He was born in 1960, graduated from Harbin Institute of Technology with doctor degree in 1989. He used to work at the National University of Defense Technology as a Post Doctor. He once was appointed as the Director and Chief Engineer of National Computer Network and Information Security Management Center, the Coordination Office Director of National Computer Network Emergency Response Technical Team/Coordination Center of China, Chairman of the Science and Technology Committee of the National Computer Network and Information Security Management Center, senior Engineer with professor title and PhD Supervisor. His main research area covers network security, information content security, parallel processing, and internet technology and so on. He is the first inventor who proposed the conception to build China National Network and Information Security Infrastructure and designed the practical corresponding system. Therefore he has successively won a first prize and two second prizes of State Scientific and Technological Progress Award. In the area of information security theory, he gave a unified formalization definition of the information security concept which involves physical security, operation security (network security), data security (narrow definition of information security) and content security. At the same time he is conducting research on the computability of the information security attribute.

Keynote 6 (Wednesday 14:00 – 15:00)

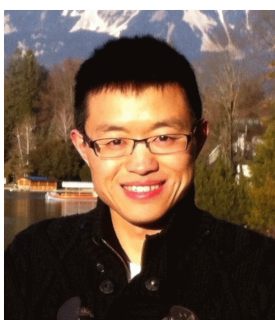
Speaker: Jie Tang, Department of Computer Science, Tsinghua University

Topic: Cognitive Graph for Understanding, Reasoning, and Decision

Abstract

We propose a novel CognitiveGraph framework for learning with knowledge graphs. Inferring new facts from existing knowledge graphs (KG) with explainable reasoning processes is a significant problem and has received much attention recently. The proposed CognitiveGraph framework is founded on the dual process theory in cognitive science. The framework gradually builds a cognitive graph in an iterative process by coordinating an implicit extraction module (System 1) and an explicit reasoning module (System 2). While giving accurate answers, our framework further provides explainable reasoning paths. Specifically, our implementation based on BERT and graph neural network (GNN) efficiently handles graph with tens of millions of nodes. The framework has many applications. For example, for multi-hop reasoning-based QA (e.g., HotpotQA), it achieves a winning joint F1 score of 34.9 on the leaderboard, compared to 23.6 of the best competitor.

Biography



Jie Tang is a Professor and the Associate Chair of the Department of Computer Science at Tsinghua University. His interests include artificial intelligence, data mining, social networks, and machine learning. He served as PC Co-Chair of WWW'21, CIKM'16, WSDM'15, Associate General Chair of KDD'18, EiC of IEEE Transactions on Big Data and AI Open Journal. He leads the project AMiner.org, an AI-enabled research network analysis system, which has attracted more than 20 million users from 220 countries/regions in the world. He was honored with the SIGKDD Test-of-Time Award, the UK Royal Society-Newton Advanced Fellowship Award, NSFC for Distinguished Young Scholar, and KDD'18 Service Award.

Conference Sessions

Session 1. **Data Intensive Applications**

Chair: Haibo Hu

GeST: A Grid Embedding based Spatio-Temporal Correlation Model for Crime Prediction

Qian, Yiting; Pan, Li; Wu, Peng; Xia, Zhengmin

Temperature Prediction Modeling and Control Parameter Optimization Based on Data Driven

Liu, Qingguang; Wei, Jielong; Lei, Sining; Huang, Qingbao

Heterogeneous Multi-Source Fusion for Ship Trajectory Complement and Prediction with Sequence Modeling

Zheng, Changmeng; Peng, Qi; Xu, Xuemiao

Session 2. **Social Networks**

Chair: Chaogang Tang

Tweet Stance Detection: A Two-stage DC-BILSTM Model Based on Semantic Attention

Yang, YuanYu; Wu, Bin; Zhao, Kai; Guo, WenYing

Personality2vec: Network Representation Learning for Personality

Guan, Zhanming; Wu, Bin; Wang, Bai; Liu, Hezi

A Unified Information Diffusion Model for Social Networks

Kong, Xiangyi; Gu, Zhaoquan; Yin, Lihua

Session 3. **Cyberspace Security, Privacy and Trust I**

Chair: Bing Zeng

Detecting DNS Tunnels Using Session Behavior and Random Forest Method

Zhao, Yang; Ye, Hongzhi; Li, Lingzi; Huang, Cheng; Zhang, Tao

Which DGA Family does A Malicious Domain Name Belong To

Zhang, Yunyi; Wu, Yuelong; Jin, Shuyuan

An APT Attack Analysis Framework Based on Self-define Rules and Mapreduce

Qi, Yulu; Jiang, Rong; Jia, Yan; Li, Aiping

A Review of APT Attack Detection Methods and Defense Strategies (Short)

Xing, Kai; li, aiping; Jiang, Rong; Jia, Yan

Unsupervised Euclidean Distance Attack on Network Embedding

Yu, Shanqing; Zheng, Jun; Chen, Jinyin; Xuan, Qi; Zhang, Qingpeng

Session 4. **Knowledge Discovery**

Chair: Zhenguo Yang

A Transformer-based Model for Sentence-Level Chinese Mandarin Lipreading (Short)

Ma, Shihui

An Advanced BERT-Based Decomposition Method for Joint Extraction of Entities and Relations

Wang, Changhai

Deep Learning for Social Network Information Cascade Analysis: A survey

Gao, Liqun; Zhou, Bin; Tu, Hongkui; Wang, Ye; Chen, Chenguang; Wang, Haiyang; Zhuang, Hongwu; Liang, Zhang

Incorporating Entity Type Information into Knowledge Representation Learning

Huang, Wenyu; Wang, Guohua; Zhang, Huakui; Chen, Feng

Context-aware Event Type Identification Based on Context Fusion and Joint Learning

Zhang, Zuowei; Tang, Yan

Session 5. **Cyberspace Security, Privacy and Trust II**

Chair: Aiping Li

Secure Data Dissemination among Multiple Base Stations in High-Speed Railway Network

Jiang, Zhongbai; Sun, Yanwei; Shi, Lei; Hu, Weihua; Liu, Zhaohui

StateConsisIV: A Privacy-preserving Integrity Verification Method for Cloud Components Based on a Novel State Consistency Feature

Fan, Peiru; Wang, Chonghua; Zhao, Bo; Ji, Zhaoxu

SecureMLDebugger: A Privacy-Preserving Machine Learning Debugging Tool

Han, Peiyi; Wang, Chaozheng; Liu, Chuanyi; Duan, Shaoming; Pan, Hezhong; Luo, Pengshuai

Session 6. **Machine Learning**

Chair: Jianming Lv

A Survey of Depth Estimation Based on Computer Vision

Liu, Yang; Jiang, Jie; Sun, Jiahao; Bai, Liang; Wang, Qi

Anobeat: Anomaly Detection for Electrocardiography Beat Signals

Ou, Yingzi; Li, Xin; Guo, Zhenyu; Wang, Yizhuo

Deep Learning-based Quantitative Steganalysis to Detect Motion Vector Embedding of HEVC Videos (Short)

Huang, Xiongbo; Hu, Yiongjian; Wang, Yufei; Liu, Beibei; Liu, Shuowei

Session 7. **Sentiment Analysis in Cyberspace**

Chair: Qingbao Huang

A Joint Model for Aspect-Category Sentiment Analysis with TextGCN and Bi-GRU

Yang, Ying; Wu, Bin; Li, Lianwei; Wang, Shuyang

Word Level Domain-Diversity Attention Based LSTM Model for Sentiment Classification

Zhang, Haoliang; Xu, Hongbo; Shi, Jinqiao; Liu, Tingwen; Liao, Chun

Multi-Task Learning Network for Document-level and Multi-aspect Sentiment Classification

Wang, Zhou

Real-time Event Detection and Tracking in Microblog via Text Chain and Sentiment Time Series

Piao, Bingxu; Wu, Xu; Wu, Jingchen; Xie, Xiaqing

A Unified Labeling Model for Open-Domain Aspect-Based Sentiment Analysis (Short)

Ji, Qian; Lin, Xiang; Ma, Yinghua; Liu, Gongshen; Wang, Shilin

Session 8. **Data Mining and IR**

Chair: An Liu

Robust Text Clustering with Graph and Textual Adversarial Learning

Liang, Yongming

GPU-BTM: A Topic Model for Short Text using Auxiliary Information

Guo, Yibing; Huang, Yu Tao; Ding, Ye; Qi, Shuhan; Wang, Xuan; Liao, Qing

Longitudinal Analysis of Cyber-Related Articles

Al Boni, Mohammad; Neeraj, Trishala

A Low-Dimensional Representation Learning Method for Text Classification and Clustering (Short)

Wang, Xiang; Liao, Yunfan; Zhu, Junxing; Zhou, Bin; Jia, Yan

Graph Convolutional Network for Visual Question Answering Based on Fine-grained Question Representation

Hu, Ze; Wei, Jielong; Huang, Qingbao; Liu, Qingguang; Zhang, Xingmao; Song, Chunling

Workshop Program

Date: 27 July, 2020 (Monday)

Big Data and Business Analytics (BDBA)

Chair: Jianshan Sun

Research on Rumor Propagation Simulation Based on Behavior-Attribute

On Improving the Learning of Long-Term historical Information for Tasks with Partial Observability

Adversarial Examples for Chinese Text Classification

BLHNN: A Novel Charge Prediction Model Based on Bi-Attention LSTM-CNN Hybrid Neural Network

Big Data Mining for Cyberspace (BDMC)

Chair: Zhaoquan Gu

A Token Level Multi-target Stance Detection Dataset

Deepfake Detection with Clustering-based Embedding Regularization

An Efficient Parallel Stochastic Gradient Descent for Matrix Factorization On GPUS

Image-based Encrypted Traffic Classification with Convolution Neural Networks

Clustering Using a Similarity Measure Approach Based on Semantic Analysis of Adversary Behaviors

Mobile Ubiquitous Systems and Technologies (MUST)

Chair: Yafei Li

Refining Co-operative Competition of Robocup Soccer with Reinforcement Learning

Join-based Social Ridesharing

A Data Traceability Method to Improve Data Quality in Big Data Environment

Multi-dimensional Data Association and Intelligent Analysis (MDATA)

Chair: Zhaoquan Gu / Aiping Li

Knowledge Fusion and Spatiotemporal Data Cleaning: A Review

Automatic Classification of Matching Rules in Pattern Matching

Chinese Open Relation Extraction with Pointer-Generator Networks

A Survey on Approaches and Applications of Knowledge Representation Learning

Contextual Gated Graph Convolutional Networks for Social Unrest Events Prediction

A Knowledge Graph Embedding Method Based on Neural Network

Seeds Optimization for Entity Alignment in Knowledge Graph Embedding

Multi-Source Network Fusion and Analysis (MSNFA)

Chair: Bin Wu

A Study of Bitcoin De-Anonymization: Graph and Multidimensional Data Analysis

Two-stage Encoding Extractive Summarization

A Parallel Algorithm for Graph Transaction Based Frequent Subgraph Mining

Sampling Topic Representative Users by Integrating Node Degree and Edge Weight

Vulnerability Analysis and Adversarial Learning (VAAL)

Chair: Zhi Wang

An Anomaly Detection Method for System Logs Using Venn-Abers Predictors

The Class Overlap Model for System Log Anomaly Detection Based on Ensemble Learning

DQ-MOTAG: Deep Reinforcement learning-based Moving Target Defense Against DDos Attacks

An Adversarial Machine Learning Method Based on OpCode N-grams Feature in Malware Detection

A Safety-Enhanced Dijkstra Routing Algorithm via SDN framework

Malicious Code Detection Technology Based on Metadata Machine Learning

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Xiaohui Tao, The University of Southern Queensland, Australia
Zhihong Tian, Guangzhou University
Guiling Wang, New Jersey Institute of Technology, USA
Tao Wang, King's College London, UK
Yufeng Wang, Nanjing University of Posts and Telecommunications
Shi-ting Wen, Zhejiang University
Jian Weng, Jinan University
Bin Wu, Beijing University of Posts and Telecommunications
Le Wu, HeFei University of Technology
Yuan Wu, Zhejiang University of Technology
Mingjun Xiao, University of Science and Technology of China
Na Xu, China University of Mining and Technology
Zhidong Xue, Huazhong University of Science and Technology
Zhenguo Yang, Guangdong University of Technology
Lihua Yin, Guangzhou University
Philip Yu, University of Illinois at Chicago, USA
Detian Zhang, Soochow University
Mingwu Zhang, Hubei University of Technology
Weizhe Zhang, Harbin Institute of Technology, China
Xiang Zhao, National University of Defence Technology
Bin Zhou, National University of Defense Technology
Hui Zhu, Xidian University
Jianming Zhu, Central University of Finance and Economics, China
Liehuang Zhu, Beijing Institute of Technology