

# **2021 IEEE International Conference on Big Knowledge (ICBK 2021)**

**Auckland, New Zealand  
7 – 8 December 2021**



**IEEE Catalog Number: CFP21M78-POD  
ISBN: 978-1-6654-3859-9**

**Copyright © 2021 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:	CFP21M78-POD
ISBN (Print-On-Demand):	978-1-6654-3859-9
ISBN (Online):	978-1-6654-3858-2

**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](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# 2021 IEEE International Conference on Big Knowledge (ICBK) ICBK 2021

## Table of Contents

Welcome from the ICBK 2021 Chairs .....	xiii
Organizing Committee .....	xv
Programme Committee .....	xvi
Track Chairs .....	xix
Keynote Abstracts .....	xx

### Keynote

Combining Deductive and Statistical Explanations in the FRANK Query Answering System .....	1
<i>Alan Bundy (University of Edinburgh, UK) and Kwabena Nuamah (University of Edinburgh, UK)</i>	

### Track 1: Machine Learning and Knowledge Graphs

Personalized Recommendation Based on Entity Attributes and Graph Features .....	7
<i>Yi Zhu (Yangzhou University, China &amp; Hefei University of Technology, China), Bingbing Dong (Hefei University of Technology, China), and Zhiqing Sha (Yangzhou University, China)</i>	
Unsupervised Type Constraint Inference in Bilinear Knowledge Graph Completion Models .....	15
<i>Yuxun Lu (National Institute of Informatics, Japan &amp; Graduate University for Advanced Studies, Japan) and Ryutaro Ichise (National Institute of Informatics, Japan &amp; Graduate University for Advanced Studies, Japan)</i>	
A Novel Homophily-Aware Correction Approach for Crowdsourced Labels Using Information Entropy .....	23
<i>Kang Yan (Anhui University, China), Jian Lu (Anhui University, China), Qingren Wang (Anhui University, China), and Wei Li (Anhui University, China)</i>	
Knowledge Distillation via Weighted Ensemble of Teaching Assistants .....	30
<i>Durga Prasad Ganta (Texas Tech University, USA), Himel Das Gupta (Texas Tech University, USA), and Victor S. Sheng (Texas Tech University, USA)</i>	

An Empirical Study of Deep Learning Frameworks for Melanoma Cancer Detection Using Transfer Learning and Data Augmentation .....	38
<i>Divya Gangwani (Florida Atlantic University, USA), Qianxin Liang (Florida Atlantic University, USA), Shuwen Wang (Florida Atlantic University, USA), and Xingquan Zhu (Florida Atlantic University, USA)</i>	
Accelerating Learning Bayesian Network Structures by Reducing Redundant CI Tests .....	46
<i>Wentao Hu (Hefei University of Technology, China), Shuai Yang (Hefei University of Technology, China), Xianjie Guo (Hefei University of Technology, China), and Kui Yu (Hefei University of Technology, China)</i>	
Surprisingness – A Novel Objective Interestingness Measure in Hypergraph Pattern Mining from Knowledge Graphs for Common Sense Learning .....	54
<i>Shujing Ke (Tilburg University, The Netherlands), Pieter Spronck (Tilburg University, The Netherlands), Ben Goertzel (SingularityNET, Hong Kong), and Alex van der Peet (Weyland Industries, The Netherlands)</i>	
Aggregation Enhanced Graph Convolutional Network for Graph Classification .....	62
<i>Guixian Zhang (Guangxi Normal University, China), Boyan Chen (Guangxi Normal University, China), Lijuan Wu (Guangxi Normal University, China), Kui Zhang (Guangxi Normal University, China), and Shichao Zhang (Guangxi Normal University, China)</i>	
HSNP-Miner: High Utility Self-Adaptive Nonoverlapping Pattern Mining .....	70
<i>Md Motaheer Hossain (Hebei University of Technology, China), Youxi Wu (Hebei University of Technology, China), Philippe Fournier-Viger (Shenzhen University, China), Zhao Li (Alibaba Group, China), Lei Guo (Hebei University of Technology, China), and Yan Li (Hebei University of Technology, China)</i>	
Graph Neural Network for Ethereum Fraud Detection .....	78
<i>Runnan Tan (Guangzhou University, China), Qingfeng Tan (Guangzhou University, China), Peng Zhang (Guangzhou University, China), and Zhao Li (Alibaba Group, China)</i>	
Label Distribution Learning by Exploiting Feature-Label Correlations Locally .....	86
<i>Gui-Lin Li (Southwest Petroleum University, China), Heng-Ru Zhang (Southwest Petroleum University, China), Yuan-Yuan Xu (Southwest Petroleum University, China), Ya-Lan Lv (Southwest Petroleum University, China), and Fan Min (Southwest Petroleum University, China)</i>	
Improving Gradient-Based DAG Learning by Structural Asymmetry .....	94
<i>Yujie Wang (Hefei University of Technology, China), Shuai Yang (Hefei University of Technology, China), Xianjie Guo (Hefei University of Technology, China), and Kui Yu (Hefei University of Technology, China)</i>	
Intuitionistic Fuzzy Requirements Aggregation for Graph Pattern Matching with Group Decision Makers .....	102
<i>Haixia Zhao (Hefei University of Technology, China), Guli Liu (Hefei University of Technology, China), Lei Li (Hefei University of Technology, China), and Jiao Li (Hefei University of Technology, China)</i>	

Meta-Path Enhanced Knowledge Graph Convolutional Network for Recommender Systems ...	110
<i>Ru Wang (Hefei University of Technology, China), Meng Wu (Hefei University of Technology, China), and Shengwei Ji (Hefei University of Technology, China)</i>	
Treatment Recommendation with Preference-Based Reinforcement Learning .....	117
<i>Nan Xu (University of Southern California, USA), Nitin Kamra (University of Southern California, USA), and Yan Liu (University of Southern California, USA)</i>	
Divide and Conquer: Targeted Adversary Detection Using Proximity and Dependency .....	125
<i>Sha Lu (University of South Australia, Australia), Lin Liu (University of South Australia, Australia), Jiuyong Li (University of South Australia, Australia), Thuc Duy Le (University of South Australia, Australia), and Jixue Liu (University of South Australia, Australia)</i>	

## Track 2: Machine Learning for Streaming Data

MTSC-GE: A Novel Graph Based Method for Multivariate Time Series Clustering .....	133
<i>Ze Yang (Hefei University of Technology, China), Changyang Tai (Hefei University of Technology, China), Gongqing Wu (Hefei University of Technology, China), Zan Zhang (Hefei University of Technology, China), and Xianyu Bao (Shenzhen Academy of Inspection and Quarantine Shenzhen, China)</i>	
Gaussian Model-Based Fully Convolutional Networks for Multivariate Time Series Classification .....	141
<i>Changyang Tai (Hefei University of Technology, China), Ze Yang (Hefei University of Technology, China), Huicheng Zhang (Hefei University of Technology, China), Gongqing Wu (Hefei University of Technology, China), Junwei Lv (Hefei University of Technology, China), and Xianyu Bao (Shenzhen Academy of Inspection and Quarantine Shenzhen, China)</i>	
An Efficient Framework for Multi-Label Learning in Non-Stationary Data Stream .....	149
<i>Xiulin Zheng (Hefei University of Technology, China) and Peipei Li (Hefei University of Technology, China)</i>	
An Efficient Framework for Sentence Similarity Inspired by Quantum Computing .....	157
<i>Yan Yu (Chongqing University of Posts and Telecommunications, China), Dong Qiu (Chongqing University of Posts and Telecommunications, China), and Ruiteng Yan (Chongqing University of Posts and Telecommunications, China)</i>	
CSRDA: Cost-Sensitive Regularized Dual Averaging for Handling Imbalanced and High-Dimensional Streaming Data .....	164
<i>Zhong Chen (Xavier University of Louisiana, USA), Zhide Fang (LSU Health Sciences Center, USA), Victor Sheng (Texas Tech University, USA), Andrea Edwards (Xavier University of Louisiana, USA), and Kun Zhang (Xavier University of Louisiana, USA)</i>	

Recognizing Characters and Relationships from Videos via Spatial-Temporal and Multimodal Cues .....	174
<i>Chenyu Cao (Beijing University of Posts and Telecommunications, China), Chenghao Yan (Beijing University of Posts and Telecommunications, China), Fangtao Li (Beijing University of Posts and Telecommunications, China), Zihe Liu (Beijing University of Posts and Telecommunications, China), Zheng Wang (Beijing University of Posts and Telecommunications, China), and Bin Wu (Beijing University of Posts and Telecommunications, China)</i>	
Recurrent Neural Networks for Learning Long-Term Temporal Dependencies with Reanalysis of Time Scale Representation .....	182
<i>Kentaro Ohno (NTT Computer and Data Science Laboratories, Japan) and Atsutoshi Kumagai (NTT Computer and Data Science Laboratories, Japan)</i>	
Temporal Analysis of Knowledge Networks .....	190
<i>Xikun Huang (University of Chinese Academy of Sciences, China), Chuanqing Wang (University of Chinese Academy of Sciences, China), Qilin Sun (University of Chinese Academy of Sciences, China), Yangyang Li (Chinese Academy of Sciences, China), and Weizhuo Li (Nanjing University of Posts and Telecommunications, China)</i>	

### Track 3: Reasoning with Knowledge Graphs

Implicit Business Competitor Inference Using Heterogeneous Knowledge Graph .....	198
<i>Wei Qin (Shanghai University, China), Xiangfeng Luo (Shanghai University, China), and Hao Wang (Shanghai University, China)</i>	
Research on Crowdsourcing Truth Inference Method Based on Graph Embedding .....	206
<i>Liangzhu Zhou (Hefei University of Technology, China), Xingrui Zhuo (Hefei University of Technology, China), Gongqing Wu (Hefei University of Technology, China), Zan Zhang (Hefei University of Technology, China), and Xianyu Bao (Shenzhen Academy of Inspection and Quarantine, China)</i>	
Jointly Modeling Fact Triples and Text Information for Knowledge Base Completion .....	214
<i>Xiuxing Li (Tsinghua University, China), Zhenyu Li (Tsinghua University, China), Zhichao Duan (Tsinghua University, China), Jiacheng Xu (Tsinghua University, China), Ning Liu (Shandong University, China), and Jianyong Wang (Tsinghua University, China)</i>	
A Scheme for Kinship Reasoning Based on Ontology .....	222
<i>Ru Chen (Ministry of Education, China &amp; Hefei University of Technology, China), Guliu Liu (Ministry of Education, China &amp; Hefei University of Technology, China), Yi Zhu (Yangzhou University, China), and Xindong Wu (Mininglamp Academy of Sciences, Mininglamp Technology, China)</i>	
A Divide-and-Conquer Method for Computing Preferred Extensions of Argumentation Frameworks.....	230
<i>Huan Zhang (University of Chinese Academy of Sciences, China) and Songmao Zhang (Chinese Academy of Sciences, China)</i>	

## Track 4: Knowledge Graph Analytics and Applications

Constructing COVID-19 Knowledge Graph from a Large Corpus of Scientific Articles .....	237
<i>Wei Emma Zhang (University of Adelaide, Australia) and Queen Nguyen (Clever Agriculture Pty. Ltd., Australia)</i>	
YABKO - Yet Another Big Knowledge Organization .....	245
<i>Ruqian Lu (Chinese Academy of Sciences, China), Chaoqun Fei (University of Chinese Academy of Sciences, China), Chuanqing Wang (University of Chinese Academy of Sciences, China), Yu Huang (Beijing Deepleaper Co., Ltd., China), and Songmao Zhang (Chinese Academy of Sciences, China)</i>	
UFreS: A New Technique for Discovering Frequent Subgraph Patterns in Uncertain Graph Databases .....	253
<i>Riddho Ridwanul Haque (University of Dhaka, Bangladesh), Chowdhury Farhan Ahmed (University of Dhaka, Bangladesh), Md. Samiullah (University of Dhaka, Bangladesh), and Carson K. Leung (University of Manitoba, Canada)</i>	
Attribute Similarity and Relevance-Based Product Schema Matching for Targeted Catalog Enrichment .....	261
<i>Evan Shieh (Amazon, USA), Saul Simhon (Amazon, USA), Geetha Aluri (Amazon, USA), Giorgos Papachristoudis (Amazon, USA), Doa Yakut (Amazon, USA), and Dhanya Raghu (Amazon, USA)</i>	
Diffxtract: Joint Discriminative Product Attribute-Value Extraction .....	271
<i>Varun Embar (University of California-Santa Cruz, USA), Andrey Kan (University of Adelaide, Australia), Bunyamin Sisman (Amazon, USA), Christos Faloutsos (Carnegie Mellon University, USA), and Lise Getoor (University of California-Santa Cruz, USA)</i>	

## Track 5: Knowledge Graphs and NLP

Global Semantics with Boundary Constraint Knowledge Graph for Chinese Financial Event Detection .....	281
<i>Yin Wang (Shanghai University, China), Nan Xia (Shanghai University, China), Xiangfeng Luo (Shanghai University, China), and Jinhui Li (Shanghai University, China)</i>	
A Semi-Supervised Bilingual Lexicon Induction Method for Distant Language Pairs Based on Bidirectional Adversarial Model .....	290
<i>Wenwu Zhi (Hefei University of Technology, China) and Yuhong Zhang (Hefei University of Technology, China)</i>	
Multi-Level Spatio-Temporal Matching Network for Multi-Turn Response Selection in Retrieval-Based Dialogue Systems .....	298
<i>Mei Ma (Xi'an Jiaotong University, China), Jianji Wang (Xi'an Jiaotong University, China), Xuguang Lan (Xi'an Jiaotong University, China), and Nanning Zheng (Xi'an Jiaotong University, China)</i>	
HfGCN: Hierarchical Fused GCN for Joint Entity and Relation Extraction .....	307
<i>Wei Nong (East China Normal University, China), Taolin Zhang (East China Normal University, China), Shuangji Yang (East China Normal University, China), Nan Hu (East China Normal University, China), and Xiaofeng He (East China Normal University, China)</i>	

Topic-Guided Knowledge Graph Construction for Argument Mining .....	315
<i>Weichen Li (Technical University of Kaiserslautern, Germany), Patrick Abels (Johannes Gutenberg University, Germany), Zahra Ahmadi (Leibniz University Hannover, Germany), Sophie Burkhardt (Technical University of Kaiserslautern, Germany), Benjamin Schiller (Technical University of Darmstadt, Germany), Iryna Gurevych (Technical University of Darmstadt, Germany), and Stefan Kramer (Johannes Gutenberg University, Germany)</i>	
Gated Graph Neural Networks (GG-NNs) for Abstractive Multi-Comment Summarization .....	323
<i>Huixin Zhan (Texas Tech University, USA), Kun Zhang (Xavier University of Louisiana, USA), Chenyi Hu (University of Central Arkansas, USA), and Victor Sheng (Texas Tech University, USA)</i>	
Multi-Round Parsing-Based Multiword Rules for Scientific Knowledge Extraction .....	331
<i>Joseph Kuebler (University of Notre Dame, USA), Lingbo Tong (University of Notre Dame, USA), and Meng Jiang (University of Notre Dame, USA)</i>	
Bridging the Language Gap: Knowledge Injected Multilingual Question Answering .....	339
<i>Zhichao Duan (Tsinghua University, China), Xiuxing Li (Tsinghua University, China), Zhengyan Zhang (Tsinghua University, China), Zhenyu Li (Tsinghua University, China), Ning Liu (Shandong University, China), and Jianyong Wang (Tsinghua University, China)</i>	
A Knowledge Enhanced Chinese GaoKao Reading Comprehension Method .....	347
<i>Xiao Zhang (Beijing Institute of Technology, China), Heqi Zheng (Beijing Institute of Technology, China), Heyan Huang (Beijing Institute of Technology, China), Zewen Chi (Beijing Institute of Technology, China), and Xian-Ling Mao (Beijing Institute of Technology, China)</i>	

## Track 6: Social Network and Representation Learning

A Proximal Alternating-Direction-Method-of-Multipliers-Based Nonnegative Latent Factor Model .....	353
<i>Fanghui Bi (Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, China &amp; University of Chinese Academy of Sciences, China) and Di Wu (Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, China &amp; University of Chinese Academy of Sciences, China)</i>	
An Ensemble Latent Factor Model for Highly Accurate Web Service QoS Prediction .....	361
<i>Peng Zhang (Chongqing University of Posts and Telecommunications, China; Chinese Academy of Sciences, China; &amp; University of Chinese Academy of Sciences, China), Yi He (Old Dominion University, USA), and Di Wu (Chinese Academy of Sciences, China)</i>	
Influence Maximization Using User Connectivity Guarantee in Social Networks .....	369
<i>Xiyu Qiao (Northeastern University, China), Yuliang Ma (Northeastern University, China), Ye Yuan (Northeastern University, China), and Xiangmin Zhou (RMIT University, Australia)</i>	



Transductive Data Augmentation with Relational Path Rule Mining for Knowledge Graph Embedding .....	377
<i>Yushi Hirose (Tokyo Institute of Technology, Japan), Masashi Shimbo (Chiba Institute of Technology, Japan &amp; Riken AIP, Japan), and Taro Watanabe (Nara Institute of Science &amp; Technology, Japan)</i>	
Fair Representation Learning in Knowledge-Aware Recommendation .....	385
<i>Bingke Xu (University of Electronic Science and Technology of China, China), Yue Cui (University of Electronic Science and Technology of China, China), Zipeng Sun (University of Electronic Science and Technology of China, China), Liwei Deng (University of Electronic Science and Technology of China, China), and Kai Zheng (University of Electronic Science and Technology of China, China)</i>	
Learning Dynamic Preference Structure Embedding from Temporal Networks .....	393
<i>Tongya Zheng (Zhejiang University, China), Zunlei Feng (Zhejiang University, China), Yu Wang (Zhejiang University, China), Chengchao Shen (Central South University, China), Mingli Song (Zhejiang University, China), Xingen Wang (Zhejiang University, China), Xinyu Wang (Zhejiang University, China), Chun Chen (Zhejiang University, China), and Hao Xu (Zhejiang Lab, China)</i>	

## Track 7: Knowledge Graphs for Education

ToFM: Topic-Specific Facet Mining by Facet Propagation within Clusters .....	402
<i>Hongxuan Li (Xi'an Jiaotong University, China), Bifan Wei (Xi'an Jiaotong University, China), Jun Liu (Xi'an Jiaotong University, China), Zhaotong Guo (Xi'an Jiaotong University, China), Jingchao Qi (Xi'an Jiaotong University, China), Bei Wu (Xi'an Jiaotong University, China), Yong Liu (Servyou Software Group Co., Ltd., China), and Yuanyuan Shi (Servyou Software Group Co., Ltd., China)</i>	
Multi-Task Learning for Multi-Turn Dialogue Generation with Topic Drift Modeling .....	410
<i>Hongwei Zeng (Xi'an Jiaotong University, China), Zhenjie Hong (Xi'an Jiaotong University, China), Jun Liu (Xi'an Jiaotong University, China), and Bifan Wei (Xi'an Jiaotong University, China)</i>	
Fuzzy c-Means Clustering with Discriminative Projection .....	418
<i>Wenjun Wu (Xi'an Jiaotong University, China), Lingling Zhang (Xi'an Jiaotong University, China), Yiwei Chen (Xi'an Jiaotong University, China), Xuan Luo (Xi'an Jiaotong University, China), Bifan Wei (Xi'an Jiaotong University, China), and Jun Liu (Xi'an Jiaotong University, China)</i>	
Consistency-Aware Multi-Modal Network for Hierarchical Multi-Label Classification in Online Education System .....	426
<i>Siqi Lei (University of Science and Technology of China, China), Wei Huang (University of Science and Technology of China, China), Shiwei Tong (University of Science and Technology of China, China), Qi Liu (University of Science and Technology of China, China), Zhenya Huang (University of Science and Technology of China, China), Enhong Chen (University of Science and Technology of China, China), and Yu Su (iFLYTEK Co., Ltd., China &amp; University of Science and Technology of China, China)</i>	

## Track 8: Operations Research, Optimisation and Machine Learning

Mining Unexpected Sequential Patterns from MOOC Data .....	434
<i>Wei Song (North China University of Technology, China) and Wei Ye (North China University of Technology, China)</i>	
Query-Focused Abstractive Summarization via Question-Answering Model .....	440
<i>JianCheng Du (Beijing Institute of Technology University, China) and Yang Gao (Beijing Institute of Technology University, China)</i>	
A Robust Mathematical Model for Blood Supply Chain Network Using Game Theory .....	448
<i>Jaber Valizadeh (Islamic Azad University, Iran), Uwe Aickelin (University of Melbourne, Australia), and Hadi Akbarzadeh Khorshidi (University of Melbourne, Australia)</i>	
Answer-Centric Local and Global Information Fusion for Conversational Question Generation .....	454
<i>Panpan Lei (Hefei University of Technology, China &amp; Hefei Comprehensive National Science Center, China) and Xiao Sun (Hefei University of Technology, China &amp; Hefei Comprehensive National Science Center, China)</i>	
A Character-Word Graph Attention Networks for Chinese Text Classification .....	462
<i>Shigang Yang (University of Electronic Science and Technology of China, China) and Yongguo Liu (University of Electronic Science and Technology of China, China)</i>	
A Genetic Algorithm for Residual Static Correction .....	470
<i>Miao Wu (Southwest Petroleum University, China), Shu-Lin Pan (Southwest Petroleum University, China), and Fan Min (Southwest Petroleum University, China)</i>	
A Survey on Optimisation-Based Semi-Supervised Clustering Methods .....	477
<i>Zahra Ghasemi (Isfahan University of Technology, Iran), Hadi Akbarzadeh Khorshidi (University of Melbourne, Australia), and Uwe Aickelin (University of Melbourne, Australia)</i>	
Question-Formed Query Suggestion .....	482
<i>Yuxin He (Beijing Institute of Technology, China), Xianling Mao (Beijing Institute of Technology, China), Wei Wei (Huazhong University of Science and Technology, China), and Heyan Huang (Beijing Institute of Technology, China)</i>	
Intervention Prediction for Patients with Pressure Injury Using Random Forest .....	490
<i>Liuqi Jin (Hefei University of Technology, China), Yan Pan (Hefei University of Technology, China), Jiaoyun Yang (Hefei University of Technology, China), Lin Han (Lanzhou University, China), Lin Lv (Gansu Provincial Hospital, China), Miki Raviv (Vitalerter Ltd., Israel), and Ning An (Hefei University of Technology, China)</i>	
<b>Author Index .....</b>	<b>497</b>