

### LNAI Series Editors

Randy Goebel

*University of Alberta, Edmonton, Canada*

Yuzuru Tanaka

*Hokkaido University, Sapporo, Japan*

Wolfgang Wahlster

*DFKI and Saarland University, Saarbrücken, Germany*

### LNAI Founding Series Editor

Joerg Siekmann

*DFKI and Saarland University, Saarbrücken, Germany*

More information about this series at <http://www.springer.com/series/1244>

Dinh Phung · Vincent S. Tseng  
Geoffrey I. Webb · Bao Ho  
Mohadeseh Ganji · Lida Rashidi (Eds.)


# Advances in Knowledge Discovery and Data Mining

22nd Pacific-Asia Conference, PAKDD 2018  
Melbourne, VIC, Australia, June 3–6, 2018  
Proceedings, Part III

*Editors*

Dinh Phung  
Deakin University  
Geelong, VIC  
Australia

Vincent S. Tseng  
National Chiao Tung University  
Hsinchu City  
Taiwan

Geoffrey I. Webb   
Monash University  
Clayton, VIC  
Australia

Bao Ho  
Japan Advanced Institute  
of Science and Technology  
Nomi, Ishikawa  
Japan

Mohadeseh Ganji  
University of Melbourne  
Melbourne, VIC  
Australia

Lida Rashidi  
University of Melbourne  
Melbourne, VIC  
Australia

ISSN 0302-9743

ISSN 1611-3349 (electronic)

Lecture Notes in Artificial Intelligence

ISBN 978-3-319-93039-8

ISBN 978-3-319-93040-4 (eBook)

<https://doi.org/10.1007/978-3-319-93040-4>

Library of Congress Control Number: 2018944425

LNCS Sublibrary: SL7 – Artificial Intelligence

© Springer International Publishing AG, part of Springer Nature 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer imprint is published by the registered company Springer International Publishing AG  
part of Springer Nature

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

## PC Chairs' Preface

With its 22nd edition in 2018, the Pacific-Asia Conference on Knowledge Discovery and Data Mining is the second oldest conference and a leading venue in the area of knowledge discovery and data mining (KDD). It provides a prestigious international forum for researchers and industry practitioners to share their new ideas, original and latest research results, and practical development experiences from all KDD-related areas, including data mining, data warehousing, machine learning, artificial intelligence, deep learning, databases, statistics, knowledge engineering, visualization, and decision-making systems.

This year, we received 592 valid submissions, which is the highest number of submissions in the past 10 years. The diversity and reputation of PAKDD were also evident from the various regions from which submissions came, with over 25 different countries, noticeably from North America and Europe. Our goal was to continue to ensure a rigorous reviewing process with each paper assigned to one Senior Program Committee (SPC) member and at least three Technical Program Committee (TPC) members, resulting in an ideal minimum number of reviews of four for each paper. Owing to the unusually large number of submissions this year, we had to increase almost doubling the number of committee members, resulting in 72 SPC members and 330 TPC members. Each valid submission was reviewed by three PC members and meta-reviewed by one SPC member who also led the discussion. This required a total of approximately 2,000 reviews. The program co-chairs then considered recommendations from the SPCs, the submission, and the reviews to make the final decision. Borderline papers were discussed intensively before final decisions were made. In some cases, additional reviews were also requested.

In the end, 164 out of 592 papers were accepted, resulting in an acceptance rate of 27.9%. Among them, 58 papers were selected for long presentation and 107 papers were selected for regular presentation. This year, we introduced a new track in Deep Learning for Knowledge Discovery and Data Mining. This track was particularly popular (70 submissions); however, in the end, the number of papers accepted as the primary category for this track was moderate (six accepted papers), standing at 8.8%. The conference program contained 32 sessions in total. Long presentations were allocated 25 minutes and regular presentations 15 mins. These two types of papers, however, are not distinguished in the proceedings.

We would like to sincerely thank all SPC members, TPC members, and external reviewers for their time, effort, dedication, and services to PAKDD 2018.

April 2018

Dinh Phung  
Vincent S. Tseng

## General Chairs' Preface

Welcome to the proceedings of the 22nd Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD). This conference has a reputable tradition in bringing researchers, academia, developers, practitioners, and industry together with a focus on the Pacific-Asian regions. This year, PAKDD was held in the wonderful city of Melbourne, Australia, during June 3–6, 2018.

The single most important element of PAKDD is the technical contributions and submissions in the area of KDD. We were very pleased with the number of submissions received this year, which was well close to 600, showing a significant boost in the number of submissions and the popularity of this conference. We sincerely thank the many authors from around the world who submitted their work to the PAKDD 2018 technical program as well as its data competition and satellite workshops. In addition, PAKDD 2018 featured three high-profile keynote speakers: Professor Kate Smith-Miles, Australian Laureate Fellow from Melbourne University; Dr. Rajeev Rastogi, Director of Machine Learning at Amazon; and Professor Bing Liu from the University of Illinois at Chicago. The conference featured three tutorials and five satellite workshops in addition to a data competition sponsored by the Fourth Paradigm Inc. and ChaLearn.

We would like to express our gratitude to the contribution of the SPC, TPC, and external reviewers, led by the program co-chairs, Dinh Phung and Vincent Tseng. We would like to thank the workshop co-chairs, Benjamin Fung and Can Wang; the tutorial co-chairs, Wray Buntine and Jeffrey Xu Yu; the competition co-chairs, Wei-Wei Tu and Hugo Jair Escalante; the local arrangements co-chairs, Gang Li and Wei-Luo; the publication co-chairs, Mohadeseh Ganji and Lida Rashidi; the Web and content co-chairs, Trung Le, Uyen Pham, and Khanh Nguyen; the publicity co-chairs, De-Chuan Zhan, Kozo Ohara, Kyuseok Shim, and Jeremiah Deng; and the award co-chairs, James Bailey, Bart Goethals, and Jinyan Li.

We are grateful to our sponsors: Deakin University as the host institution and gold sponsor; Monash University as the gold sponsor, University of Melbourne, Trusting Social, and the Asian Office of Aerospace Research and Development/Air Force Office of Scientific Research as silver sponsors, Springer as the publication sponsor, and the Fourth Paradigm, CodaLab and ChaLearn as the data competition sponsors.

April 2017

Tu-Bao Ho  
Geoffrey I. Webb

# Organization

## Organizing Committee

### General Co-chairs

Geoffrey I. Webb	Monash University, Australia
Bao Ho	Japan Advanced Institute of Science and Technology, Japan

### Program Committee Co-chairs

Dinh Phung	Deakin University, Australia
Vincent Tseng	National Chiao Tung University, Taiwan

### Tutorial Co-chairs

Wray Buntine	Monash University, Australia
Jeffrey Xu Yu	Chinese University of Hong Kong, Hong Kong, SAR China

### Workshop Co-chairs

Benjamin Fung	McGill University, Canada
Can Wang	Griffith University, Australia

### Data Competition Co-chairs

Wei-Wei Tu	Fourth Paradigm Inc., China
Hugo Jair Escalante	INAOE Mexico, ChaLearn, USA

### Publicity Co-chairs

De-Chuan Zhan	Nanjing University, China
Kozo Ohara	Aoyama Gakuin University, Japan
Kyuseok Shim	Seoul National University, South Korea
Jeremiah Deng	University of Otago, New Zealand

### Publication Co-chairs

Mohadeseh Ganji	University of Melbourne, Australia
Lida Rashidi	University of Melbourne, Australia

### Local Arrangements Co-chairs

Gang Li	Deakin University, Australia
Wei Luo	Deakin University, Australia

## Web and Content Co-chairs

Trung Le	Deakin University, Australia
Uyen Pham	Vietnam National University, Vietnam

## Award Co-chairs

James Bailey	University of Melbourne, Australia
Bart Goethals	University of Antwerp, Belgium
Jinyan Li	University of Technology Sydney, Australia

## Steering Committee

### Co-chairs

Ee-Peng Lim	Singapore Management University, Singapore
Takashi Washio	Institute of Scientific and Industrial Research, Osaka University, Japan

### Treasurer

Longbing Cao	Advanced Analytics Institute, University of Technology, Sydney, Australia
--------------	--

### Members

Ee-Peng Lim	Singapore Management University, Singapore (member since 2006, co-chair 2015–2017)
P. Krishna Reddy	International Institute of Information Technology, Hyderabad (IIIT-H), India (member since 2010)
Joshua Z. Huang	Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China (member since 2011)
Longbing Cao	Advanced Analytics Institute, University of Technology, Sydney (member since 2013)
Jian Pei	Simon Fraser University, Canada (member since 2013)
Myra Spiliopoulou	Otto von Guericke University Magdeburg, Germany (member since 2013)
Vincent S. Tseng	National Chiao Tung University, Taiwan (member since 2014)
Tru Hoang Cao	Ho Chi Minh City University of Technology, Vietnam (member since 2015)
Gill Dobbie	University of Auckland, New Zealand (member since 2016)
Kyuseok Shim	Seoul National University, South Korea

### Life Members

Hiroshi Motoda	AFOSR/AOARD and Osaka University, Japan (member since 1997, co-chair 2001–2003, chair 2004–2006, life member since 2006)
Rao Kotagiri	University of Melbourne, Australia (member since 1997, co-chair 2006–2008, chair 2009–2011, life member since 2007, treasury Co-sign since 2006)
Huan Liu	Arizona State University, USA (member since 1998, treasurer 1998–2000, life member since 2012)
Ning Zhong	Maebashi Institute of Technology, Japan (member since 1999, life member since 2008)
Masaru Kitsuregawa	Tokyo University, Japan (member since 2000, life member since 2008)
David Cheung	University of Hong Kong, SAR China (member since 2001, treasurer 2005–2006, chair 2006–2008, life member since 2009)
Graham Williams	Australian National University, Australia (member since 2001, treasurer since 2006, co-chair 2009–2011, chair 2012–2014, life member since 2009)
Ming-Syan Chen	National Taiwan University, Taiwan, ROC (member since 2002, life member since 2010)
Kyu-Young Whang	Korea Advanced Institute of Science and Technology, South Korea (member since 2003, life member since 2011)
Chengqi Zhang	University of Technology Sydney, Australia (member since 2004, life member since 2012)
Tu Bao Ho	Japan Advanced Institute of Science and Technology, Japan (member since 2005, co-chair 2012–2014, chair 2015–2017, life member since 2013)
Zhi-Hua Zhou	Nanjing University, China (member since 2007, life member since 2015)
Jaideep Srivastava	University of Minnesota, USA (member since 2006, life member since 2015)
Takashi Washio	Institute of Scientific and Industrial Research, Osaka University (member since 2008, life member since 2016)
Thanaruk Theeramunkong	Thammasat University, Thailand (member since 2009)

### Past Members

Hongjun Lu	Hong Kong University of Science and Technology, Hong Kong, SAR China (member 1997–2005)
Arbee L. P. Chen	National Chengchi University, Taiwan, ROC (member 2002–2009)
Takao Terano	Tokyo Institute of Technology, Japan (member 2000–2009)

## Senior Program Committee

Albert Bifet	Universite Paris-Saclay, France
Andrzej Skowron	University of Warsaw, Poland
Benjamin C. M. Fung	McGill University, Canada
Byung Suk Lee	University of Vermont, USA
Chandan Reddy	Virginia Tech, USA
Chuan Shi	Beijing University of Posts and Telecommunications, China
Dat Tran	University of Canberra, Australia
Dinh Phung	Deakin University, Australia
Eibe Frank	University of Waikato, New Zealand
Feida Zhu	Singapore Management University, Singapore
Gang Li	Deakin University, Australia
Geoff Holmes	University of Waikato, New Zealand
George Karypis	University of Minnesota, USA
Guozhu Dong	Wright State University, USA
Hanghang Tong	City University of New York, USA
Hu Xia	Texas A&M University, USA
Hui Xiong	Rutgers University, USA
Jae-Gil Lee	KAIST, South Korea
James Bailey	University of Melbourne, Australia
Jeffrey Xu Yu	Chinese University of Hong Kong, Hong Kong, SAR China
Jia Wu	Macquarie University, Australia
Jian Pei	Simon Fraser University, Canada
Jianyong Wang	Tsinghua University, China
Jiliang Tang	Michigan State University, USA
Jiuyong Li	University of South Australia, Australia
Joshua Huang	Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China
Kai Ming Ting	Federation University, Australia
Kamalakar Karlapalem	International Institute of Information Technology, Hyderabad, India
Krishna Reddy P.	International Institute of Information Technology, Hyderabad, India
Kyuseok Shim	Seoul National University, South Korea
Latifur Khan	University of Texas at Dallas, USA
Longbing Cao	University of Technology Sydney, Australia
Masashi Sugiyama	University of Tokyo, Japan
Michael Berthold	University of Konstanz, Germany
Ming Li	Nanjing University, China
Min-Ling Zhang	Southeast University, China
Nikos Mamoulis	University of Ioannina, Greece
Niloy Ganguly	IIT, Kharagpur, India
Nitin Agarwal	University of Arkansas at Little Rock, USA

Olivier DeVel	DST, Australia
Osmar Goethals	University of Antwerp, Belgium
Patrick Gallinari	LIP6, Université Pierre et Marie Curie, France
Paul Montague	DST, Australia
Peter Christen	Australian National University, Australia
R. K. Agarwal	Jawaharlal Nehru University, India
Rajeev Raman	University of Leicester, UK
Reza Haffari	Monash University, Australia
Sang-Wook Kim	Hanyang University, South Korea
Seungwon Hwang	Yonsei University, South Korea
Shengjun Huang	Nanjing University of Aeronautics and Astronautics, China
Takashi Washio	Institute of Scientific and Industrial Research, Osaka University, Japan
Trung Le	Deakin University, Australia
Truyen Tran	Deakin University, Australia
Tu Nguyen	Deakin University, Australia
U. Kang	Seoul National University, South Korea
Vincenzo Piuri	Università degli Studi di Milano, Italy
Wee Keong Ng	Nanyang Technological University, Singapore
Wei Wang	University of California, Los Angeles, USA
Weidong Cai	University of Sydney, Australia
Wen-Chih Peng	National Chiao Tung University, Taiwan
Xiangjun Dong	Qilu University of Technology, China
Xiaofang Zhou	University of Queensland, Australia
Xiaohua Hu	Drexel University, USA
Xindong Wu	University of Vermont, USA
Xing Xie	Microsoft Research Asia, China
Xintao Wu	University of Arkansas, USA
Xuan Vinh Nguyen	University of Melbourne, Australia
Xuan-Hong Dang	IBM T. J. Watson Research Center, USA
Yan Wang	Macquarie University, Australia
Yanchun Zhang	Victoria University, Australia
Yu Zheng	Microsoft Research Asia, China
Yue Xu	Queensland University of Technology, Australia
Zhao Zhang	Soochow University, China

## Program Committee

Adriel Cheng	Defence Science and Technology Group, Australia
Aijun An	York University, Canada
Aixin Sun	Nanyang Technological University, Singapore
Akihiro Inokuchi	Kwansei Gakuin University, Japan
Angelo Genovese	Università degli Studi di Milano, Italy
Anne Denton	North Dakota State University, USA

Arnaud Giacometti	François Rabelais University, France
Arnaud Soulet	François Rabelais University, France
Arthur Zimek	University of Southern Denmark, Denmark
Athanasios Nikolakopoulos	University of Minnesota, USA
Bay Vo	Ho Chi Minh City University of Technology, Vietnam
Bettina Berendt	Katholieke Universiteit Leuven, Belgium
Bin Liu	IBM T. J. Watson Research Center, USA
Bing Xue	Victoria University of Wellington, New Zealand
Bo Jin	Dalian University of Technology, China
Bolin Ding	Microsoft Research, USA
Brendon Woodford	University of Otago, New Zealand
Bruno Cremilleux	Université de Caen Normandie, France
Bum-Soo Kim	Korea University, South Korea
Canh Hao Nguyen	Kyoto University, Japan
Carson Leung	University of Manitoba, Canada
Chao Lan	University of Wyoming, USA
Chao Qian	University of Science and Technology of China, China
Chedy Raissi	Inria, France
Chen Chen	Nankai University, China
Chengzhang Zhu	University of Technology Sydney, Australia
Chenping Hou	National University of Defence Technology, China
Chia Hui Chang	National Central University, Taiwan
Choochart Haruechaiyasak	National Electronics and Computer Technology Centre, NECTEC, Thailand
Chuan Shi	Beijing University of Posts and Telecommunications, China
Chulyun Kim	Sookmyung Women's University, South Korea
Chun-Hao Chen	Tamkang University, Taiwan
Dao-Qing Dai	Sun Yat-Sen University, China
Dat Tran	University of Canberra, Australia
David Anastasiu	San José State University, USA
David Taniar	Monash University, Australia
David Tse Jung Huang	University of Auckland, New Zealand
De-Chuan Zhan	Nanjing University, China
Defu Lian	University of Electronic Science and Technology of China, China
Dejing Dou	University of Oregon, USA
De-Nian Yang	Academia Sinica, Taiwan
Dhaval Patel	IBM T. J. Watson Research Center, USA
Dinh Quoc Tran	University of North Carolina at Chapel Hill, USA
Divyesh Jadav	IBM Research, USA
Dragan Gamberger	Rudjer Boskovic Institute, Croatia
Du Zhang	California State University, USA
Duc Dung Nguyen	Institute of Information Technology, Vietnam
Elham Naghizade	University of Melbourne, Australia
Enhong Chen	University of Science and Technology of China, China

Enrique Ballester	Università degli Studi di Milano, Italy
Fabio Stella	University of Milano-Bicocca, Italy
Fan Zhang	University of New South Wales, Australia
Florent Masseglia	Inria, France
Francois Petitjean	Monash University, Australia
Fuzhen Zhuang	Institute of Computing Technology, Chinese Academy of Sciences, China
Gang Li	Deakin University, Australia
Gillian Dobbie	University of Auckland, New Zealand
Giuseppe Manco	Università della Calabria, Italy
Goce Ristanoski	Data61, Australia
Guandong Xu	University of Technology Sydney, Australia
Guangzhong Sun	University of Science and Technology of China, China
Guansong Pang	University of Technology Sydney, Australia
Gustavo Batista	University of Sao Paulo, Brazil
Hady Lauw	Singapore Management University, Singapore
Heitor Gomes	Telecom ParisTech, France
Hiroaki Shiokawa	University of Tsukuba, Japan
Hiroyuki Toda	NTT Cyber Solutions Laboratories, NTT Corporation, Japan
Hong Shen	Adelaide University, Australia
Hongzhi Yin	University of Queensland, Australia
Hsuan-Tien Lin	National Taiwan University, Taiwan
Hui (Wendy) Wang	Stevens Institute of Technology, USA
Hung-Yu Kao	National Cheng Kung University, Taiwan
Huzefa Rangwala	George Mason University, USA
Ichigaku Takigawa	Hokkaido University, Japan
Ickjai Lee	James Cook University, Australia
Irena Koprinska	University of Sydney, Australia
Jaegul Choo	Korea University, South Korea
Jason Wang	New Jersey Institute of Technology, USA
Jean Paul Barddal	Pontifical Catholic University of São Paulo, PUC-PR, Brazil
Jeffrey Chan	RMIT University, Australia
Jeffrey Ullman	Stanford University, USA
Jen-Wei Huang	National Cheng Kung University, Taiwan
Jeremiah Deng	University of Otago, New Zealand
Jerry Chun-Wei Lin	Harbin Institute of Technology, China
Jiajun Liu	Renmin University of China, China
Jiamou Liu	University of Auckland, New Zealand
Jiangang Ma	James Cook University, Australia
Jianhua Yin	Shandong University, China
Jianmin Li	Tsinghua University, China
Jianxin Li	University of Western Australia, Australia
Jia-Yu Pan	Google, USA
Jie Liu	Nankai University, China

Jing Zhang	Nanjing University of Science and Technology, China
Jingrui He	IBM Research, USA
Jingwei Xu	Nanjing University, China
Jingyuan Yang	Rutgers University, USA
Joao Vinagre	LIAAD – INESC Tec, Porto, Portugal
Johannes Bloemer	University of Paderborn, Germany
Jörg Wicker	University of Auckland, New Zealand
Joyce Jiyoung Whang	Sungkyunkwan University, South Korea
Jun Gao	Peking University, China
Jun Luo	Lenovo, Hong Kong, SAR China
Junbin Gao	University of Sydney, Australia
Jundong Li	Arizona State University, USA
Jungeun Kim	KAIST, South Korea
Jun-Ki Min	Korea University of Technology and Education, South Korea
Junping Zhang	Fudan University, China
K. Selçuk Candan	Arizona State University, USA
Keith Chan	Hong Kong Polytechnic University, Hong Kong, SAR China
Kevin Bouchard	Université du Quebec a Chicoutimi, Canada
Khoat Than	Hanoi University of Science and Technology, Vietnam
Ki Yong Lee	Sookmyung Women's University, South Korea
Ki-Hoon Lee	Kwangwoon University, South Korea
Kitsana Waiyamai	Kasetsart University, Thailand
Kok-Keong Ong	La Trobe University, Australia
Kouzou Ohara	Aoyama Gakuin University, Japan
Krisztian Buza	University of Bonn, Germany
Kui Yu	University of South Australia, Australia
Kun-Ta Chuang	National Cheng Kung University, Taiwan
Kyoung-Sook Kim	Artificial Intelligence Research Centre, South Korea
Latifur Khan	University of Texas, USA
Le Wu	Hefei University of Technology, China
Lei Gu	Nanjing University of Post and Telecommunications, China
Leong Hou U	University of Macau, SAR China
Liang Hu	Jilin University, China
Liang Hu	University of Technology Sydney, Australia
Liang Wu	Arizona State University, USA
Lida Rashidi	University of Melbourne, Australia
Lijie Wen	Tsinghua University, China
Lin Liu	University of South Australia, Australia
Lin Wu	University of Queensland, Australia
Ling Chen	University of Technology Sydney, Australia
Lizhen Wang	Yunnan University, China
Long Yuan	University of New South Wales, Australia
Lu Zhang	University of Arkansas, USA

Luiza Antonie	University of Guelph, Canada
Maciej Grzenda	Warsaw University of Technology, Poland
Mahito Sugiyama	National Institute of Informatics, Japan
Mahsa Salehi	Monash University, Australia
Makoto Kato	Kyoto University, Japan
Marco Maggini	University of Siena, Italy
Marzena Kryszkiewicz	Warsaw University of Technology, Poland
Md Zahidul Islam	Charles Sturt University, Australia
Meng Chang Chen	Academia Sinica, Taiwan
Meng Jiang	University of Illinois, USA
Miao Xu	RIKEN, Japan
Michael E. Houle	National Institute of Informatics, Japan
Michael Hahsler	Southern Methodist University, USA
Ming Li	Nanjing University, China
Ming Tang	Chinese Academy of Sciences, China
Ming Yin	Microsoft Research and Purdue University, USA
Mingbo Zhao	Donghua University, China
Min-Ling Zhang	Southeast University, China
Miyuki Nakano	Advanced Institute of Industrial Technology, Japan
Mohadeseh Ganji	University of Melbourne, Australia
Mohit Sharma	Walmart Labs, USA
Mostafa Haghir Chehreghani	Telecom Paristech, France
Motoki Shiga	GIFU University, Japan
Muhammad Aamir Cheema	Monash University, Australia
Murat Kantarcioglu	University of Texas at Dallas, USA
Nam Huynh	Japan Advanced Institute of Science and Technology, Japan
Nayyar Zaidi	Monash University, Australia
Ngoc-Thanh Nguyen	Wroclaw University of Technology, Poland
Nguyen Le Minh	Japan Advanced Institute of Science and Technology, Japan
Noseong Park	University of North Carolina at Charlotte, USA
P Sastry	IISc, India
P. Krishna Reddy	International Institute of Information Technology Hyderabad, India
Pabitra Mitra	Indian Institute of Technology Kharagpur, India
Panagiotis Papapetrou	Stockholm University, Sweden
Patricia Riddle	University of Auckland, New Zealand
Peixiang Zhao	Florida State University, USA
Pengpeng Zhao	Soochow University, China
Philippe Fournier-Viger	Harbin Institute of Technology, China
Philippe Lenca	IMT Atlantique, France
Qi Liu	University of Science and Technology of China, China
Qiang Tang	Luxembourg institute of Science and Technology, Luxembourg

Qing Wang	Australian National University, Australia
Qingshan Liu	Nanjing University of Information Science and Technology, China
Ranga Vatsavai	North Carolina State University, USA
Raymond Chi-Wing Wong	Hong Kong University of Science and Technology, Hong Kong, SAR China
Reza Zafarani	Syracuse University, USA
Rong-Hua Li	Shenzhen University, China
Rui Camacho	University of Porto, Portugal
Rui Chen	Samsung Research America, USA
Sael Lee	SUNY, South Korea
Sangkeun Lee	Korea University, South Korea
Sanjay Jain	National University of Singapore, Singapore
Santu Rana	Deakin University, Australia
Sarah Erfani	University of Melbourne, Australia
Satoshi Hara	Osaka University, Japan
Satoshi Oyama	Hokkaido University, Japan
Shanika Karunasekera	University of Melbourne, Australia
Sheng Li	Adobe Research, USA
Shirui Pan	University of Technology Sydney, Australia
Shiyu Yang	University of New South Wales, Australia
Shoji Hirano	Shimane University, Japan
Shoujin Wang	University of Technology Sydney, Australia
Shu Wu	NLPR, China
Shu-Ching Chen	Florida International University, USA
Shuhan Yuan	University of Arkansas, USA
Shuigeng Zhou	Fudan University, China
Sibo Wang	University of Queensland, Australia
Silvia Chiusano	Polytechnic University of Turin, Italy
Simon James	Deakin University, Australia
Songcan Chen	Nanjing University of Aeronautics and Astronautics, China
Songlei Jian	University of Technology Sydney, Australia
Steven Ding	McGill University, Canada
Suhang Wang	Arizona State University, USA
Sunhwan Lee	IBM Research, USA
Sunil Gupta	Deakin University, Australia
Tadashi Nomoto	National Institute of Japanese Literature, Japan
Takehiro Yamamoto	Kyoto University, Japan
Takehisa Yairi	University of Tokyo, Japan
Tanmoy Chakraborty	University of Maryland, College Park, USA
Teng Zhang	Nanjing University, China
Tetsuya Yoshida	Nara Women's University, Japan
Thanh Nguyen	Deakin University, Australia
Thin Nguyen	Deakin University, Australia
Tho Quan	John Von Neumann Institute, Vietnam

Tong Xu	University of Science and Technology of China, China
Toshihiro Kamishima	National Institute of Advanced Industrial Science and Technology, Japan
Trong Dinh Thac Do	University of Technology, Sydney, Australia
Tru Cao	Ho Chi Minh City University of Technology, Vietnam
Tuan-Anh Hoang	Leibniz University of Hanover, Germany
Tzung-Pei Hong	National University of Kaohsiung, Taiwan
Vien Ngo	Queen's University Belfast, UK
Viet Huynh	Deakin University, Australia
Vincenzo Piuri	University of Milan, Italy
Vineeth Mohan	Arizona State University, USA
Vladimir Estivill-Castro	Griffith University, Australia
Wai Lam	Chinese University of Hong Kong, Hong Kong, SAR China
Wang-Chien Lee	Pennsylvania State University, USA
Wei Ding	University of Massachusetts Boston, USA
Wei Kang	University of South Australia, Australia
Wei Liu	UTS, Australia, Australia
Wei Luo	Deakin University, Australia
Wei Shen	Nankai University, China
Wei Wang	University of New South Wales, Australia
Wei Zhang	ECNU, China
Weiqing Wang	University of Queensland, Australia
Wenjie Zhang	University of New South Wales, Australia
Wilfred Ng	HKUST, China
Woong-Kee Loh	Gacheon University, South Korea
Xian Wu	Microsoft Research Asia, China
Xiangfu Meng	Liaoning Technical University, China
Xiangjun Dong	Qilu University of Technology, China
Xiangliang Zhang	King Abdullah University of Science and Technology, Saudi Arabia
Xiangmin Zhou	RMIT University, Australia
Xiangnan He	National University of Singapore, Singapore
Xiangnan Kong	Worcester Polytechnic Institute, USA
Xiaodong Yue	Shanghai University, China, China
Xiaofeng Meng	Renmin University of China, China
Xiaohui (Daniel) Tao	University of Southern Queensland, Australia
Xiaoying Gao	Victoria University of Wellington, New Zealand
Xin Huang	Hong Kong Baptist University, Hong Kong, SAR China
Xin Wang	University of Calgary, Canada
Xingquan Zhu	Florida Atlantic University, USA
Xintao Wu	University of Arkansas, USA
Xiuzhen Zhang	RMIT University, Australia
Xuan Vinh Nguyen	University of Melbourne, Australia

Xuan-Hieu Phan	University of Engineering and Technology – VNUHN, Vietnam
Xuan-Hong Dang	UC Santa Barbara, USA
Xue Li	University of Queensland, Australia
Xuelong Li	Chinese Academy of Science, China
Xuhui Fan	University of Technology Sydney, Australia
Yaliang Li	University at Buffalo, USA
Yanchang Zhao	CSIRO, Australia
Yang Gao	Nanjing University, China
Yang Song	University of Sydney, Australia
Yang Wang	University of New South Wales, Australia
Yang Yu	Nanjing University, China
Yang-Sae Moon	Kangwon National University, South Korea
Yanjie Fu	Missouri University of Science and Technology, USA
Yao Zhou	Arizona State University, USA
Yasuhiko Morimoto	Hiroshima University, Japan
Yasuo Tabei	RIKEN Centre for Advanced Intelligent Project, Japan
Yating Zhang	RIKEN AIP Centre/NAIST, Japan
Yidong Li	Beijing Jiaotong University, China
Yi-Dong Shen	Chinese Academy of Sciences, China
Yifeng Zeng	Teesside University, UK
Yim-ming Cheung	Hong Kong Baptist University, Hong Kong, SAR China
Ying Zhang	University of New South Wales, Australia
Yi-Ping Phoebe Chen	La Trobe University, Australia
Yi-Shin Chen	National Tsing Hua University, Taiwan
Yong Guan	Iowa State University, USA
Yong Zheng	Illinois Institute of Technology, USA
Yongkai Wu	University of Arkansas, USA
Yuan Yao	Nanjing University, China
Yuanyuan Zhu	Wuhan University, China
Yücel Saygın	Sabancı University, Turkey
Yue-Shi Lee	Ming Chuan University, Taiwan
Yu-Feng Li	Nanjing University, China
Yun Sing Koh	University of Auckland, New Zealand
Yuni Xia	Indiana University – Purdue University Indianapolis (IUPUI), USA
Yuqing Sun	Shandong University, China
Zhangyang Wang	Texas A&M University, USA
Zhaohong Deng	Jiangnan University, China
Zheng Liu	Nanjing University of Posts and Telecommunications, China
Zhenhui (Jessie Li)	Pennsylvania State University, USA
Zhiyuan Chen	University of Maryland Baltimore County, USA
Zhongfei Zhang	Binghamton University, USA
Zhou Zhao	Zhejiang University, China

Zhu Xiaofeng	Guangxi Normal University, China
Zijun Yao	Rutgers University, USA
Zili Zhang	Deakin University, Australia
Josh Jia-Ching Ying	Feng Chia University, Taiwan
Ja-Hwung Su	Cheng Shiu University, Taiwan
Chun-Hao Chen	Tamkang University, Taiwan
Chih-Ya Shen	National Tsing Hua University, Taiwan
Chih-Hua Tai	National Taipei University, Taiwan
Chien-Liang Liu	National Chiao Tung University, Taiwan
Ming-Feng Tsai	National Chengchi University, Taiwan
Hon-Han Shuai	National Chiao Tung University, Taiwan
Hoang Trong Nghia	MIT, USA
Bo Dao	Deakin University, Australia
Dang Nguyen	Deakin University, Australia
Binh Nguyen	Deakin University, Australia

**Sponsors**



**MONASH**  
University



## Contents – Part III

### Feature Learning and Data Mining Process

Discovering High Utility Itemsets Based on the Artificial Bee Colony Algorithm . . . . .	3
<i>Wei Song and Chaomin Huang</i>	
A Scalable and Efficient Subgroup Blocking Scheme for Multidatabase Record Linkage . . . . .	15
<i>Thilina Ranbaduge, Dinusha Vatsalan, and Peter Christen</i>	
Efficient Feature Selection Framework for Digital Marketing Applications . . .	28
<i>Wei Zhang, Shiladitya Bose, Said Kobeissi, Scott Tomko, and Chris Challis</i>	
Dynamic Feature Selection Algorithm Based on Minimum Vertex Cover of Hypergraph. . . . .	40
<i>Xiaojun Xie and Xiaolin Qin</i>	
Feature Selection for Multiclass Binary Data . . . . .	52
<i>Kushani Perera, Jeffrey Chan, and Shanika Karunasekera</i>	
Scalable Model-Based Cascaded Imputation of Missing Data . . . . .	64
<i>Jacob Montiel, Jesse Read, Albert Bifet, and Talel Abdesslem</i>	
On Reducing Dimensionality of Labeled Data Efficiently. . . . .	77
<i>Guoxi Zhang, Tomoharu Iwata, and Hisashi Kashima</i>	
Using Metric Space Indexing for Complete and Efficient Record Linkage . . .	89
<i>Özgür Akgün, Alan Dearle, Graham Kirby, and Peter Christen</i>	
Dimensionality Reduction via Community Detection in Small Sample Datasets . . . . .	102
<i>Kartikeya Bhardwaj and Radu Marculescu</i>	
An Interaction-Enhanced Feature Selection Algorithm . . . . .	115
<i>Xiaochuan Tang, Yuanshun Dai, Yanping Xiang, and Liang Luo</i>	
An Extended Random-Sets Model for Fusion-Based Text Feature Selection . . . . .	126
<i>Abdullah Semran Alharbi, Yuefeng Li, and Yue Xu</i>	

Attribute Reduction Algorithm Based on Improved Information Gain Rate and Ant Colony Optimization . . . . .	139
<i>Jipeng Wei, Qianjin Wei, and Yimin Wen</i>	

Efficient Approximate Algorithms for the Closest Pair Problem in High Dimensional Spaces. . . . .	151
<i>Xingyu Cai, Sanguthevar Rajasekaran, and Fan Zhang</i>	

Efficient Compression Technique for Sparse Sets . . . . .	164
<i>Rameshwar Pratap, Ishan Sohony, and Raghav Kulkarni</i>	

It Pays to Be Certain: Unsupervised Record Linkage via Ambiguity Minimization . . . . .	177
<i>Anna Jurek and Deepak P.</i>	

### **Community Detection and Network Science**

Consensus Community Detection in Multilayer Networks Using Parameter-Free Graph Pruning. . . . .	193
<i>Domenico Mandaglio, Alessia Amelio, and Andrea Tagarelli</i>	

Community Discovery Based on Social Relations and Temporal-Spatial Topics in LBSNs . . . . .	206
<i>Shuai Xu, Jiuxin Cao, Xuelin Zhu, Yi Dong, and Bo Liu</i>	

A Unified Weakly Supervised Framework for Community Detection and Semantic Matching . . . . .	218
<i>Wenjun Wang, Xiao Liu, Pengfei Jiao, Xue Chen, and Di Jin</i>	

Tapping Community Memberships and Devising a Novel Homophily Modeling Approach for Trust Prediction . . . . .	231
<i>Pulkit Parikh, Manish Gupta, and Vasudeva Varma</i>	

### **Deep Learning Theory and Applications in KDD**

Text-Visualizing Neural Network Model: Understanding Online Financial Textual Data. . . . .	247
<i>Tomoki Ito, Hiroki Sakaji, Kota Tsubouchi, Kiyoshi Izumi, and Tatsuo Yamashita</i>	

MIDA: Multiple Imputation Using Denoising Autoencoders . . . . .	260
<i>Lovedeep Gondara and Ke Wang</i>	

Dual Control Memory Augmented Neural Networks for Treatment Recommendations. . . . .	273
<i>Hung Le, Truyen Tran, and Svetha Venkatesh</i>	

Denoising Time Series Data Using Asymmetric Generative Adversarial Networks . . . . .	285
<i>Sunil Gandhi, Tim Oates, Tinoosh Mohsenin, and David Hairston</i>	
Shared Deep Kernel Learning for Dimensionality Reduction. . . . .	297
<i>Xinwei Jiang, Junbin Gao, Xiaobo Liu, Zhihua Cai, Dongmei Zhang, and Yuanxing Liu</i>	
CDSSD: Refreshing Single Shot Object Detection Using a Conv-Deconv Network . . . . .	309
<i>Vijay Gabale and Uma Sawant</i>	
Binary Classification of Sequences Possessing Unilateral Common Factor with AMS and APR . . . . .	322
<i>Yujin Tang, Kei Yonekawa, Mori Kurokawa, Shinya Wada, and Kiyohito Yoshihara</i>	
Automating Reading Comprehension by Generating Question and Answer Pairs . . . . .	335
<i>Vishwajeet Kumar, Kireeti Boorla, Yogesh Meena, Ganesh Ramakrishnan, and Yuan-Fang Li</i>	
Emotion Classification with Data Augmentation Using Generative Adversarial Networks . . . . .	349
<i>Xinyue Zhu, Yifan Liu, Jiahong Li, Tao Wan, and Zengchang Qin</i>	
Trans2Vec: Learning Transaction Embedding via Items and Frequent Itemsets . . . . .	361
<i>Dang Nguyen, Tu Dinh Nguyen, Wei Luo, and Svetha Venkatesh</i>	
Detecting Complex Sensitive Information via Phrase Structure in Recursive Neural Networks. . . . .	373
<i>Jan Neerbek, Ira Assent, and Peter Dolog</i>	
<b>Clustering and Unsupervised Learning</b>	
A Distance Scaling Method to Improve Density-Based Clustering. . . . .	389
<i>Ye Zhu, Kai Ming Ting, and Maia Angelova</i>	
Neighbourhood Contrast: A Better Means to Detect Clusters Than Density . . . . .	401
<i>Bo Chen and Kai Ming Ting</i>	
Clustering of Multiple Density Peaks. . . . .	413
<i>Borui Cai, Guangyan Huang, Yong Xiang, Jing He, Guang-Li Huang, Ke Deng, and Xiangmin Zhou</i>	

A New Local Density for Density Peak Clustering . . . . .	426
<i>Zhishuai Guo, Tianyi Huang, Zhiling Cai, and William Zhu</i>	
An Efficient Ranking-Centered Density-Based Document Clustering Method. . . . .	439
<i>Wathsala Anupama Mohotti and Richi Nayak</i>	
Fast Manifold Landmarking Using Locality-Sensitive Hashing . . . . .	452
<i>Zay Maung Maung Aye, Benjamin I. P. Rubinstein, and Kotagiri Ramamohanarao</i>	
Equitable Conceptual Clustering Using OWA Operator . . . . .	465
<i>Noureddine Aribi, Abdelkader Ouali, Yahia Lebbah, and Samir Loudni</i>	
Unsupervised Extremely Randomized Trees . . . . .	478
<i>Kevin Dalleau, Miguel Couceiro, and Malika Smail-Tabbone</i>	
Local Graph Clustering by Multi-network Random Walk with Restart . . . . .	490
<i>Yaowei Yan, Dongsheng Luo, Jingchao Ni, Hongliang Fei, Wei Fan, Xiong Yu, John Yen, and Xiang Zhang</i>	
Scalable Approximation Algorithm for Graph Summarization . . . . .	502
<i>Maham Anwar Beg, Muhammad Ahmad, Arif Zaman, and Imdadullah Khan</i>	
<b>Privacy-Preserving and Security</b>	
RIPEX: Extracting Malicious IP Addresses from Security Forums Using Cross-Forum Learning . . . . .	517
<i>Joobin Gharibshah, Evangelos E. Papalexakis, and Michalis Faloutsos</i>	
Pattern-Mining Based Cryptanalysis of Bloom Filters for Privacy-Preserving Record Linkage . . . . .	530
<i>Peter Christen, Anushka Vidanage, Thilina Ranbaduge, and Rainer Schnell</i>	
A Privacy Preserving Bayesian Optimization with High Efficiency . . . . .	543
<i>Thanh Dai Nguyen, Sunil Gupta, Santu Rana, and Svetha Venkatesh</i>	
Randomizing SVM Against Adversarial Attacks Under Uncertainty. . . . .	556
<i>Yan Chen, Wei Wang, and Xiangliang Zhang</i>	

## Recommendation and Data Factorization

One for the Road: Recommending Male Street Attire . . . . .	571
<i>Debopriyo Banerjee, Niloy Ganguly, Shamik Sural, and Krothapalli Sreenivasa Rao</i>	
Context-Aware Location Annotation on Mobility Records Through User Grouping . . . . .	583
<i>Yong Zhang, Hua Wei, Xuelian Lin, Fei Wu, Zhenhui Li, Kaiheng Chen, Yuandong Wang, and Jie Xu</i>	
A Joint Optimization Approach for Personalized Recommendation Diversification . . . . .	597
<i>Xiaojie Wang, Jianzhong Qi, Kotagiri Ramamohanarao, Yu Sun, Bo Li, and Rui Zhang</i>	
Personalized Item-of-Interest Recommendation on Storage Constrained Smartphone Based on Word Embedding Quantization . . . . .	610
<i>Si-Ying Huang, Yung-Yu Chen, Hung-Yuan Chen, Lun-Chi Chen, and Yao-Chung Fan</i>	

## Social Network, Ubiquitous Data and Graph Mining

Topic-Specific Retweet Count Ranking for Weibo. . . . .	625
<i>Hangyu Mao, Yang Xiao, Yuan Wang, Jiakang Wang, and Zhen Xiao</i>	
Motif-Aware Diffusion Network Inference . . . . .	638
<i>Qi Tan, Yang Liu, and Jiming Liu</i>	
Tri-Fly: Distributed Estimation of Global and Local Triangle Counts in Graph Streams . . . . .	651
<i>Kijung Shin, Mohammad Hammoud, Euiwoong Lee, Jinoh Oh, and Christos Faloutsos</i>	
WFSM-MaxPWS: An Efficient Approach for Mining Weighted Frequent Subgraphs from Edge-Weighted Graph Databases . . . . .	664
<i>Md. Ashraful Islam, Chowdhury Farhan Ahmed, Carson K. Leung, and Calvin S. H. Hoi</i>	
A Game-Theoretic Adversarial Approach to Dynamic Network Prediction . . .	677
<i>Jia Li, Brian Ziebart, and Tanya Berger-Wolf</i>	
Targeted Influence Minimization in Social Networks . . . . .	689
<i>Xinjue Wang, Ke Deng, Jianxin Li, Jeffery Xu Yu, Christian S. Jensen, and Xiaochun Yang</i>	
Maximizing Social Influence on Target Users. . . . .	701
<i>Yu-Ting Wen, Wen-Chih Peng, and Hong-Han Shuai</i>	

Team Expansion in Collaborative Environments . . . . .	713
<i>Lun Zhao, Yuan Yao, Guibing Guo, Hanghang Tong, Feng Xu, and Jian Lu</i>	
HashAlign: Hash-Based Alignment of Multiple Graphs . . . . .	726
<i>Mark Heimann, Wei Lee, Shengjie Pan, Kuan-Yu Chen, and Danai Koutra</i>	
Evaluating and Analyzing Reliability over Decentralized and Complex Networks . . . . .	740
<i>Jaron Mar, Jiamou Liu, Yanni Tang, Wu Chen, and Tianyi Sun</i>	
Efficient Exact and Approximate Algorithms for Computing Betweenness Centrality in Directed Graphs . . . . .	752
<i>Mostafa Haghiri Chehreghani, Albert Bifet, and Talel Abdesslem</i>	
Forecasting Bitcoin Price with Graph Chainlets. . . . .	765
<i>Cuneyt G. Akcora, Asim Kumer Dey, Yulia R. Gel, and Murat Kantarcioglu</i>	
Information Propagation Trees for Protest Event Prediction . . . . .	777
<i>Jeffery Ansah, Wei Kang, Lin Liu, Jixue Liu, and Jiuyong Li</i>	
Predictive Team Formation Analysis via Feature Representation Learning on Social Networks . . . . .	790
<i>Lo Pang-Yun Ting, Cheng-Te Li, and Kun-Ta Chuang</i>	
Leveraging Local Interactions for Geolocating Social Media Users . . . . .	803
<i>Mohammad Ebrahimi, Elaheh ShafieiBavani, Raymond Wong, and Fang Chen</i>	
Utilizing Sequences of Touch Gestures for User Verification on Mobile Devices . . . . .	816
<i>Liron Ben Kimon, Yisroel Mirsky, Lior Rokach, and Bracha Shapira</i>	
<b>Author Index . . . . .</b>	<b>829</b>