

# **Lecture Notes in Artificial Intelligence**

**10234**

Subseries of Lecture Notes in Computer Science

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>

Jinho Kim · Kyuseok Shim  
Longbing Cao · Jae-Gil Lee  
Xuemin Lin · Yang-Sae Moon (Eds.)

# Advances in Knowledge Discovery and Data Mining

21st Pacific-Asia Conference, PAKDD 2017  
Jeju, South Korea, May 23–26, 2017  
Proceedings, Part I

*Editors*

Jinho Kim  
Kangwon National University  
Chuncheon  
Korea (Republic of)

Kyuseok Shim  
Seoul National University  
Seoul  
Korea (Republic of)

Longbing Cao   
University of Technology Sydney  
Sydney, NSW  
Australia

Jae-Gil Lee  
KAIST  
Daejeon  
Korea (Republic of)

Xuemin Lin  
University of New South Wales  
Sydney, NSW  
Australia

Yang-Sae Moon   
Kangwon National University  
Chuncheon  
Korea (Republic of)

ISSN 0302-9743                      ISSN 1611-3349 (electronic)  
Lecture Notes in Artificial Intelligence  
ISBN 978-3-319-57453-0              ISBN 978-3-319-57454-7 (eBook)  
DOI 10.1007/978-3-319-57454-7

Library of Congress Control Number: 2017938164

LNCS Sublibrary: SL7 – Artificial Intelligence

© Springer International Publishing AG 2017

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 Springer Nature  
The registered company is Springer International Publishing AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

## PC Chairs' Preface

It is our great pleasure to introduce the proceedings of the 21st Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD 2017).

We received a record-breaking number of 458 submissions from 36 countries all over the world. This highest number of submissions is very encouraging because it reflects the improving status of PAKDD. To rigorously review the submissions, we conducted a double-blind review following the tradition of PAKDD and constructed the largest ever committee consisting of 38 Senior Program Committee (SPC) members and 196 Program Committee (PC) members. Each valid submission was reviewed by three PC members and meta-reviewed by one SPC member who also led the discussion with the PC members. We, the PC co-chairs, considered the recommendations from the SPC members and looked into each submission as well as its reviews to make the final decisions. Borderline papers were thoroughly discussed by us before final decisions were made.

As a result, 129 out of 458 papers were accepted, yielding an acceptance rate of 28.2%. Among them, 45 papers were selected as long-presentation papers, and 84 papers were selected as regular-presentation papers. Mining social networks or graph data was the most popular topic in the accepted papers. The review process was supported by the Microsoft CMT system. During the three main conference days, these 129 papers were presented in 23 research sessions. A long-presentation paper was given 25 minutes for presentation, and a regular-presentation paper was given 15 minutes for presentation. These two types of papers, however, are not distinguished in the proceedings.

We would like to thank all SPC members, PC members, and external reviewers for their hard work to provide us with thoughtful and comprehensive reviews and recommendations. Also, we would like to express our sincere thanks to Yang-Sae Moon for compiling all accepted papers and for working with the Springer team to produce the proceedings.

We hope that the readers of the proceedings find the content interesting and rewarding.

April 2017

Longbing Cao  
Jae-Gil Lee  
Xuemin Lin

## General Chairs' Preface

Welcome to the proceedings of the 21st Pacific-Asia Conference on Knowledge Discovery and Data Mining. PAKDD has successfully brought together researchers and developers since 1997, with the purpose of identifying challenging problems facing the development of advanced knowledge discovery. After 14 years since PAKDD 2003 in Seoul, PAKDD was held again in Korea, during May 23–26, 2017, in Jeju Island.

We are very grateful to the many authors who submitted their work to the PAKDD 2017 technical program. The technical program was enhanced by three keynote speeches, delivered by Sang Cha from Seoul National University, Rakesh Agrawal from Data Insights Laboratories, and Dacheng Tao from the University of Sydney. In addition to the main technical program, the offerings of this conference were further enriched by three tutorials as well as four international workshops on leading-edge topics.

We would like to acknowledge the key contributions by Program Committee co-chairs, Longbing Cao, Jae-Gil Lee, and Xuemin Lin. We would like to extend our gratitude to the workshop co-chairs, U. Kang, Ee-Peng Lim, and Jeffrey Xu Yu; the tutorial co-chairs, Dongwon Lee, Yasushi Sakurai, and Hwanjo Yu; the contest co-chairs, Nitesh Chawla, Younghoon Kim, and Young-Koo Lee; the publicity co-chairs, Sang-Won Lee, Guoliang Li, Steven Whang, and Xiaofang Zhou; the registration co-chairs, Min-Soo Kim and Wookey Lee; the local Arrangements co-chairs, Joonho Kwon, Jun-Ki Min, Chan Jung Park, and Young-Ho Park; the Web chair, Ha-Joo Song; the finance co-chairs, Jaewoo Kang and Jaesoo Yoo; the treasury chair, Chulyun Kim; and the proceedings chair, Yang-Sae Moon. We would like to express our special thanks to our honorary chair, Kyu-Young Whang, for providing valuable advice on all aspects of the conference's organization.

We are grateful to our sponsors that include: platinum sponsors — Asian Office of Aerospace Research & Development/Air Force Office of Scientific Research, Mirhenge, Naver, NCSOFT, Seoul National University Big Data Institute and SK Holdings C&C; gold sponsors — KISTI (Korea Institute of Science and Technology Information); silver sponsors — Daumsoft, Douzone, HiBrainNet, Korea Data Agency, and SK Telecom; and publication sponsors — Springer for their generous and valuable support. We are also thankful to the PAKDD Steering Committee for its guidance and Best Paper Award, Student Travel Award, and Early Career Research Award sponsorship. In addition, we would like to express our gratitude to the KIISE Database Society of Korea for hosting this conference. Finally, we thank the student volunteers and everyone who helped us in organizing PAKDD 2017.

April 2017

Jinho Kim  
Kyuseok Shim

## Organization

## Organizing Committee

## Honorary Chair

Kyu-Young Whang      DGIST/KAIST, Korea

## General Co-chairs

Jinho Kim                      Kangwon National University, Korea  
Kyuseok Shim                Seoul National University, Korea

## Program Committee Co-chairs

Longbing Cao                  University of Technology Sydney, Australia  
Jae-Gil Lee                   KAIST, Korea  
Xuemin Lin                   University of New South Wales, Australia

## Tutorial Co-chairs

|                 |                                    |
|-----------------|------------------------------------|
| Dongwon Lee     | Pennsylvania State University, USA |
| Yasushi Sakurai | Kumamoto University, Japan         |
| Hwanjo Yu       | POSTECH, Korea                     |

## Workshop Co-chairs

|               |                                                |
|---------------|------------------------------------------------|
| U Kang        | Seoul National University, Korea               |
| Ee-Peng Lim   | Singapore Management University, Singapore     |
| Jeffrey Xu Yu | The Chinese University of Hong Kong, SAR China |

## Publicity Co-chairs

|                      |                                     |
|----------------------|-------------------------------------|
| Sang-Won Lee         | Sungkyunkwan University, Korea      |
| Guoliang Li          | Tsinghua University, China          |
| Steven Euijong Whang | Google Research, USA                |
| Xiaofang Zhou        | University of Queensland, Australia |

## Finance Co-chairs

Jaewoo Kang  
Jaesoo Yoo

## Treasury Chair

Chulyun Kim Sookmyung Women's University, Korea

### **Proceedings Chair**

Yang-Sae Moon                      Kangwon National University, Korea

### **Contest Co-chairs**

Nitesh Chawla                      University of Notre Dame, USA  
Younghoon Kim                    Hanyang University, Korea  
Young-Koo Lee                    Kyung Hee University, Korea

### **Local Arrangements Co-chairs**

Joonho Kwon                      Pusan National University, Korea  
Jun-Ki Min                        Korea University of Technology and Education, Korea  
Chan Jung Park                    Jeju National University, Korea  
Young-Ho Park                    Sookmyung Women's University, Korea

### **Registration Co-chairs**

Min-Soo Kim                      DGIST, Korea  
Wookey Lee                        Inha University, Korea

### **Web Chair**

Ha-Joo Song                      Pukyong National University, Korea

## **Steering Committee**

### **Co-chairs**

Tu Bao Ho                        Japan Advanced Institute of Science and Technology,  
                                                 Japan  
Ee-Peng Lim                      Singapore Management University, Singapore

### **Treasurer**

Graham Williams                Togaware, Australia (see also under Life Members)

### **Members**

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)  
Ee-Peng Lim                      Singapore Management University, Singapore (Member  
                                                 since 2006, Co-chair 2015–2017)  
Thanaruk                        Thammasat University, Thailand (Member since 2009)  
    Theeramunkong  
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      | University of Technology Sydney, Australia<br>(Member since 2013)         |
| Jian Pei          | Simon Fraser University, Canada (Member since 2013)                       |
| Myra Spiliopoulou | Otto von Guericke University of Magdeburg, Germany<br>(Member since 2013) |
| Vincent S. Tseng  | National Cheng Kung University, Taiwan<br>(Member since 2014)             |
| Tru Hoang Cao     | Ho Chi Minh City University of Technology, Vietnam<br>(Member since 2015) |
| Gill Dobbie       | University of Auckland, New Zealand<br>(Member since 2016)                |

### Life Members

|                    |                                                                                                                                                        |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hiroshi Motoda     | AFOSR/AOARD and Osaka University, Japan<br>(Member since 1997, Co-chair 2001–2003,<br>Chair 2004–2006, Life Member since 2006)                         |
| Rao Kotagiri       | University of Melbourne, Australia (Member since 1997,<br>Co-chair 2006–2008, Chair 2009–2011, Life Member<br>since 2007, Treasury Co-sign since 2006) |
| Huan Liu           | Arizona State University, USA (Member since 1998,<br>Treasurer 1998–2000, Life Member since 2012)                                                      |
| Ning Zhong         | Maebashi Institute of Technology, Japan (Member since<br>1999, Life Member since 2008)                                                                 |
| Masaru Kitsuregawa | Tokyo University, Japan (Member since 2000,<br>Life Member since 2008)                                                                                 |
| David Cheung       | University of Hong Kong, SAR China (Member since<br>2001, Treasurer 2005–2006, Chair 2006–2008,<br>Life Member since 2009)                             |
| Graham Williams    | Australian National University, Australia (Member since<br>2001, Treasurer since 2006, Co-chair 2009–2011,<br>Chair 2012–2014, Life Member since 2009) |
| Ming-Syan Chen     | National Taiwan University, Taiwan, ROC (Member since<br>2002, Life Member since 2010)                                                                 |
| Kyu-Young Whang    | Korea Advanced Institute of Science and Technology,<br>Korea (Member since 2003, Life Member since 2011)                                               |
| Chengqi Zhang      | University of Technology Sydney, Australia (Member<br>since 2004, Life Member since 2012)                                                              |
| Zhi-Hua Zhou       | Nanjing University, China (Member since 2007, Life<br>Member since 2015)                                                                               |
| Jaideep Srivastava | University of Minnesota, USA (Member since 2006,<br>Life Member since 2015)                                                                            |
| Takashi Washio     | Institute of Scientific and Industrial Research,<br>Osaka University, Japan (Member since 2008,<br>Life Member since 2016)                             |

## Past Members

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

## Senior Program Committee

|                   |                                                                                 |
|-------------------|---------------------------------------------------------------------------------|
| James Bailey      | The University of Melbourne, Australia                                          |
| Peter Christen    | The Australian National University, Australia                                   |
| Guozhu Dong       | Wright State University, USA                                                    |
| Patrick Gallinari | LIP6, Université Pierre et Marie Curie, France                                  |
| Joshua Huang      | Shenzhen University, China                                                      |
| Seung-won Hwang   | Yonsei University, Korea                                                        |
| George Karypis    | University of Minnesota, USA                                                    |
| Latifur Khan      | The University of Texas at Dallas, USA                                          |
| Sang-Wook Kim     | Hanyang University, Korea                                                       |
| Byung Suk Lee     | University of Vermont, USA                                                      |
| Jiuyong Li        | University of South Australia, Australia                                        |
| Nikos Mamoulis    | University of Hong Kong, SAR China                                              |
| Wee Keong Ng      | Nanyang Technological University, Singapore                                     |
| Wen-Chih Peng     | National Chiao Tung University, Taiwan                                          |
| Vincenzo Piuri    | Università degli Studi di Milano, Italy                                         |
| Rajeev Raman      | University of Leicester, UK                                                     |
| P. Krishna Reddy  | International Institute of Information Technology,<br>Hyderabad (IIIT-H), India |
| Dou Shen          | Baidu, China                                                                    |
| Masashi Sugiyama  | RIKEN/The University of Tokyo, Japan                                            |
| Kai Ming Ting     | Federation University, Australia                                                |
| Hanghang Tong     | Arizona State University, USA                                                   |
| Vincent S. Tseng  | National Chiao Tung University, Taiwan                                          |
| Jianyong Wang     | Tsinghua University, China                                                      |
| Wei Wang          | University of California, Los Angeles, USA                                      |
| Takashi Washio    | Osaka University, Japan                                                         |
| Xindong Wu        | University of Louisiana at Lafayette, USA                                       |
| Xing Xie          | Microsoft Research Asia, China                                                  |
| Hui Xiong         | Rutgers University, USA                                                         |
| Yue Xu            | Queensland University of Technology, Australia                                  |
| Hayato Yamana     | Waseda University, Japan                                                        |
| Jin Soung Yoo     | Indiana University-Purdue University Fort Wayne, USA                            |
| Jeffrey Yu        | The Chinese University of Hong Kong, SAR China                                  |
| Osmar Zaiane      | University of Alberta, Canada                                                   |
| Zhao Zhang        | Soochow University, China                                                       |

|               |                                         |
|---------------|-----------------------------------------|
| Yanchun Zhang | Victoria University, Australia          |
| Yu Zheng      | Microsoft Research Asia, China          |
| Ning Zhong    | Maebashi Institute of Technology, Japan |
| Xiaofang Zhou | The University of Queensland, Australia |

### Program Committee

|                          |                                                           |
|--------------------------|-----------------------------------------------------------|
| Aijun An                 | York University, Canada                                   |
| Enrique Muñoz Ballester  | Università degli Studi di Milano, Italy                   |
| Gustavo Batista          | University of Sao Paulo, Brazil                           |
| Johannes Blömer          | Paderborn University, Germany                             |
| Kevin Bouchard           | Université du Québec à Chicoutimi, Canada                 |
| Krisztian Buza           | Rheinische Friedrich-Wilhelms-Universität Bonn, Germany   |
| K. Selcuk Candan         | Arizona State University, USA                             |
| Tru Hoang Cao            | Ho Chi Minh City University of Technology, Vietnam        |
| Wei Cao                  | HeFei University of Technology, China                     |
| Tanmoy Chakraborty       | University of Maryland, College Park, USA                 |
| Jeffrey Chan             | RMIT University, Australia                                |
| Chia-Hui Chang           | National Central University, Taiwan                       |
| Muhammad Aamir Cheema    | Monash University, Australia                              |
| Chun-Hao Chen            | Tamkang University, Taiwan                                |
| Enhong Chen              | University of Science and Technology of China, China      |
| Shu-Ching Chen           | Florida International University, USA                     |
| Ling Chen                | University of Technology Sydney, Australia                |
| Meng Chang Chen          | Academia Sinica, Taiwan                                   |
| Yi-Ping Phoebe Chen      | La Trobe University, Australia                            |
| Songcan Chen             | Nanjing University of Aeronautics and Astronautics, China |
| Zhiyuan Chen             | University of Maryland Baltimore County, USA              |
| Zheng Chen               | Microsoft Research Asia, China                            |
| Silvia Chiusano          | Politecnico di Torino, Italy                              |
| Jaegul Choo              | Korea University, Korea                                   |
| Kun-Ta Chuang            | National Cheng Kung University, Taiwan                    |
| Bruno Cremilleux         | Université de Caen, France                                |
| Alfredo Cuzzocrea        | ICAR-CNR and University of Calabria, Italy                |
| Xuan-Hong Dang           | UC Santa Barbara, USA                                     |
| Zhaohong Deng            | Jiangnan University, China                                |
| Anne Denton              | North Dakota State University, USA                        |
| Lipika Dey               | Tata Consultancy Services, India                          |
| Bolin Ding               | Microsoft Research, USA                                   |
| Gillian Dobbie           | The University of Auckland, New Zealand                   |
| Xiangjun Dong            | Qilu University of Technology, China                      |
| Dejing Dou               | University of Oregon, USA                                 |
| Vladimir Estivill-Castro | Griffith University, Australia                            |
| Xuhui Fan                | University of Technology Sydney, Australia                |

|                             |                                                                            |
|-----------------------------|----------------------------------------------------------------------------|
| Philippe Fournier-Viger     | Harbin Institute of Technology Shenzhen, China                             |
| Yanjie Fu                   | Missouri University of Science and Technology, USA                         |
| Jun Gao                     | Peking University, China                                                   |
| Yang Gao                    | Nanjing University, China                                                  |
| Junbin Gao                  | University of Sydney, Australia                                            |
| Xiaoying Gao                | Victoria University of Wellington, New Zealand                             |
| Angelo Genovese             | Università degli Studi di Milano, Italy                                    |
| Arnaud Giacometti           | University François Rabelais of Tours, France                              |
| Lei Gu                      | Nanjing University of Post and Telecommunications,<br>China                |
| Yong Guan                   | Iowa State University, USA                                                 |
| Stephan Günnemann           | Technical University of Munich, Germany                                    |
| Sunil Gupta                 | Deakin University, Australia                                               |
| Michael Hahsler             | Southern Methodist University, USA                                         |
| Choochart<br>Haruechaiyasak | National Electronics and Computer Technology Center,<br>Thailand           |
| Tzung-Pei Hong              | National University of Kaohsiung, Taiwan                                   |
| Michael Houle               | NII, Japan                                                                 |
| Qingbo Hu                   | LinkedIn, USA                                                              |
| Liang Hu                    | Jilin University, China                                                    |
| Jen-Wei Huang               | National Cheng Kung University, Taiwan                                     |
| Nguyen Quoc Viet Hung       | University of Queensland, Australia                                        |
| Van-Nam Huynh               | Japan Advanced Institute of Science and Technology,<br>Japan               |
| Yoshiharu Ishikawa          | Nagoya University, Japan                                                   |
| Md Zahidul Islam            | Charles Sturt University, Australia                                        |
| Divyesh Jadav               | IBM Almaden Research, USA                                                  |
| Meng Jiang                  | University of Illinois at Urbana-Champaign, USA                            |
| Toshihiro Kamishima         | National Institute of Advanced Industrial Science<br>and Technology, Japan |
| Murat Kantarcioglu          | University of Texas at Dallas, USA                                         |
| Hung-Yu Kao                 | National Cheng Kung University, Taiwan                                     |
| Shanika Karunasekera        | The University of Melbourne, Australia                                     |
| Makoto Kato                 | Kyoto University, Japan                                                    |
| Yoshinobu Kawahara          | Osaka University, Japan                                                    |
| Bum-Soo Kim                 | Korea University, Korea                                                    |
| Chulyun Kim                 | Sookmyung Women's University, Korea                                        |
| Kyoung-Sook Kim             | National Institute of Advanced Industrial Science<br>and Technology, Japan |
| Yun Sing Koh                | The University of Auckland, New Zealand                                    |
| Irena Koprinka              | University of Sydney, Australia                                            |
| Sejeong Kwon                | KAIST, Korea                                                               |
| Hady Lauw                   | Singapore Management University, Singapore                                 |
| Ickjai Lee                  | James Cook University, Australia                                           |
| Jongwuk Lee                 | Sungkyunkwan University, Korea                                             |
| Ki-Hoon Lee                 | Kwangwoon University, Korea                                                |

|                    |                                                              |
|--------------------|--------------------------------------------------------------|
| Ki Yong Lee        | Sookmyung Women's University, Korea                          |
| Kyumin Lee         | Utah State University, USA                                   |
| Yue-Shi Lee        | Ming Chuan University, Taiwan                                |
| Sunhwan Lee        | IBM Almaden Research Center, USA                             |
| Wang-Chien Lee     | Pennsylvania State University, USA                           |
| SangKeun Lee       | Korea University, Korea                                      |
| Philippe Lenca     | IMT Atlantique, France                                       |
| Carson K. Leung    | University of Manitoba, Canada                               |
| Zhenhui Li         | Pennsylvania State University, USA                           |
| Dancheng Li        | Northeastern University, China                               |
| Gang Li            | Deakin University, Australia                                 |
| Jianmin Li         | Tsinghua University, China                                   |
| Ming Li            | Nanjing University, China                                    |
| Sheng Li           | Northeastern University, USA                                 |
| Xiaoli Li          | Institute for Infocomm Research, Singapore                   |
| Xuelong Li         | Chinese Academy of Science, China                            |
| Yaliang Li         | University at Buffalo, USA                                   |
| Yidong Li          | Beijing Jiaotong University, China                           |
| Zhixu Li           | Soochow University, China                                    |
| Hsuan-Tien Lin     | National Taiwan University, Taiwan                           |
| Jerry Chun-Wei Lin | Harbin Institute of Technology Shenzhen, China               |
| Jiajun Liu         | Renmin University, China                                     |
| Bin Liu            | IBM T.J. Watson Research Center, USA                         |
| Wei Liu            | University of Technology Sydney, Australia                   |
| Woong-Kee Loh      | Gachon University, Korea                                     |
| Shuai Ma           | Beihang University, China                                    |
| Giuseppe Manco     | Università della Calabria, Italy                             |
| Florent Maseglia   | Inria, France                                                |
| Yasuko Matsubara   | Kumamoto University, Japan                                   |
| Xiangfu Meng       | Liaoning Technical University, China                         |
| Jun-Ki Min         | Korea University of Technology and Education, Korea          |
| Nguyen Le Minh     | JAIST, Japan                                                 |
| Yasuhiko Morimoto  | Hiroshima University, Japan                                  |
| Miyuki Nakano      | Advanced Institute of Industrial Technology, Japan           |
| Wilfred Ng         | Hong Kong University of Science and Technology,<br>SAR China |
| Ngoc-Thanh Nguyen  | Wroclaw University of Technology, Poland                     |
| Xuan Vinh Nguyen   | University of Melbourne, Australia                           |
| Kouzou Ohara       | Aoyama Gakuin University, Japan                              |
| Salvatore Orlando  | Ca' Foscari University of Venice, Italy                      |
| Satoshi Oyama      | Hokkaido University, Japan                                   |
| Jia-Yu Pan         | Google, USA                                                  |
| Shirui Pan         | University of Technology Sydney, Australia                   |
| Guansong Pang      | University of Technology Sydney, Australia                   |
| Noseong Park       | University of North Carolina, Charlotte, USA                 |
| Gabriella Pasi     | University of Milano-Bicocca, Italy                          |

|                          |                                                                             |
|--------------------------|-----------------------------------------------------------------------------|
| Dhaval Patel             | IBJ T.J. Watson Research Center, USA                                        |
| Dinh Phung               | Deakin University, Australia                                                |
| Santu Rana               | Deakin University, Australia                                                |
| P. Krishna Reddy         | International Institute of Information Technology<br>Hyderabad, India       |
| Chandan Reddy            | Virginia Tech, USA                                                          |
| Patricia Riddle          | University of Auckland, New Zealand                                         |
| P.S. Sastry              | Indian Institute of Science, Bangalore, India                               |
| Jiwon Seo                | Ulsan National Institute of Science and Technology, Korea                   |
| Hong Shen                | Adelaide University, Australia                                              |
| Bin Shen                 | Zhejiang University, China                                                  |
| Chuan Shi                | Beijing University of Posts and Telecommunications,<br>China                |
| Arnaud Soulet            | François Rabelais University of Tours, France                               |
| Fabio Stella             | University of Milano-Bicocca, Italy                                         |
| Mahito Sugiyama          | Osaka University, Japan                                                     |
| Yuqing Sun               | Shangdong University, China                                                 |
| Yasuo Tabei              | Tokyo Institute of Technology, Japan                                        |
| Ichigaku Takigawa        | Hokkaido University, Japan                                                  |
| Ming Tang                | Chinese Academy of Sciences, China                                          |
| David Taniar             | Monash University, Australia                                                |
| Xiaohui (Daniel) Tao     | The University of Southern Queensland, Australia                            |
| Khoat Than               | Hanoi University of Science and Technology, Vietnam                         |
| Hiroyuki Toda            | NTT Cyber Solutions Laboratories, NTT Corporation,<br>Japan                 |
| Ranga Raju Vatsavai      | North Carolina University, USA                                              |
| Zhangyang Wang           | Texas A&M University, USA                                                   |
| Lizhen Wang              | Yunnan University, China                                                    |
| Ruili Wang               | Massey University (Albany Campus), New Zealand                              |
| Shoujin Wang             | Advanced Analytics Institute, University of Technology<br>Sydney, Australia |
| Jason Wang               | New Jersey Institute of Technology, USA                                     |
| Yang Wang                | University of New South Wales, Australia                                    |
| Wei Wang                 | University of New South Wales, Australia                                    |
| Xin Wang                 | University of Calgary, Canada                                               |
| Lijie Wen                | Tsinghua University, China                                                  |
| Steven Euijong Whang     | Google Research, USA                                                        |
| Joyce Jiyoung Whang      | Sungkyunkwan University, Korea                                              |
| Raymond Chi-Wing<br>Wong | Hong Kong University of Science and Technology,<br>SAR China                |
| Brendon Woodford         | University of Otago, New Zealand                                            |
| Lin Wu                   | University of Queensland, Australia                                         |
| Jia Wu                   | University of Technology Sydney, Australia                                  |
| Xintao Wu                | University of Arkansas, USA                                                 |
| Yuni Xia                 | Indiana University - Purdue University Indianapolis<br>(IUPUI), USA         |

|                   |                                                       |
|-------------------|-------------------------------------------------------|
| Guandong Xu       | University of Technology Sydney, Australia            |
| Congfu Xu         | Zhejiang University, China                            |
| Bing Xue          | Victoria University of Wellington, New Zealand        |
| Takehiro Yamamoto | Kyoto University, Japan                               |
| Yusuke Yamamoto   | Kyoto University, Japan                               |
| Jianye Yang       | UNSW, Australia                                       |
| Ming Yang         | Nanjing Normal University, China                      |
| Shiyu Yang        | UNSW, Australia                                       |
| Min Yao           | Zhejiang University, China                            |
| Ilyeop Yi         | KAIST, Korea                                          |
| Hongzhi Yin       | University of Queensland, Australia                   |
| Ming Yin          | Harvard University, USA                               |
| Yang Yu           | Nanjing University, China                             |
| Long Yuan         | UNSW, Australia                                       |
| Xiaodong Yue      | Shanghai University, China                            |
| Se-Young Yun      | Los Alamos National Laboratory, USA                   |
| Yifeng Zeng       | Teesside University, UK                               |
| Fan Zhang         | University of Technology Sydney, Australia            |
| Junping Zhang     | Fudan University, China                               |
| Xiuzhen Zhang     | RMIT University, Australia                            |
| Yating Zhang      | Kyoto University, Japan                               |
| Ying Zhang        | University of New South Wales, Australia              |
| Du Zhang          | Macau University of Science and Technology, SAR China |
| Min-Ling Zhang    | Southeast University, China                           |
| Wenjie Zhang      | University of New South Wales, Australia              |
| Zhongfei Zhang    | Binghamton University, USA                            |
| Peixiang Zhao     | Florida State University, USA                         |
| Yong Zheng        | Illinois Institute of Technology, USA                 |
| Shuigeng Zhou     | Fudan University, China                               |
| Xiangmin Zhou     | RMIT University, Australia                            |
| Chengzhang Zhu    | National University of Defense Technology, China      |
| Xingquan Zhu      | Florida Atlantic University, USA                      |
| Arthur Zimek      | University of Southern Denmark, Denmark               |

### Additional Reviewers

|                   |                  |
|-------------------|------------------|
| Enzo Acerbi       | Zhao Kang        |
| Weiling Cai       | Daehoon Kim      |
| Minsoo Choy       | Jungeun Kim      |
| Thomas Devogele   | Sundong Kim      |
| Van Nguyen Do     | Nicolas Labroche |
| Khan Chuong Duong | Trung Le         |
| Laurent Etienne   | Chengjun Li      |
| Li Gao            | Dominique Li     |
| Viet Huynh        | Wentao Li        |

Chun-Yi Liu  
Jing Lv  
Kiem-Hieu Nguyen  
Oanh Nguyen  
Thin Nguyen  
Thuong Nguyen  
Tu Nguyen  
Vu Nguyen  
Linshan Shen  
Fengyi Song  
Hwanjun Song  
Gabriele Sottocornola

Linh Ngo Van  
Yanran Wang  
Yisen Wang  
Kuoliang Wu  
Hongyu Xu  
Wanqi Yang  
Xuesong Yang  
Haichao Yu  
Hanchao Yu  
Chen Zhang  
Chenwei Zhang  
Yuhai Zhao



## Sponsors

### Platinum Sponsors

AFOSR/  
AOARD

이르헨지

**NAVER**

**NCSoft** 

 **BIG DATA INSTITUTE**  
Seoul National University

**SK**  **holdings**  
C&C

### Gold Sponsor

 **KiSTi** Korea Institute of  
Science and Technology Information  
[www.kisti.re.kr](http://www.kisti.re.kr)

### Silver Sponsors

**Daumsoft**  
MINING MINDS

**DOUZONE**

 **HiBrain.Net**

 **Kdata** 한국데이터진흥원  
Korea Data Agency

 **SK telecom**

### Publication Sponsor

 **Springer**

# Contents – Part I

## Classification and Deep Learning

|                                                                                                                           |     |
|---------------------------------------------------------------------------------------------------------------------------|-----|
| Convolutional Bi-directional LSTM for Detecting Inappropriate Query Suggestions in Web Search. . . . .                    | 3   |
| <i>Harish Yenala, Manoj Chinnakotla, and Jay Goyal</i>                                                                    |     |
| A Fast and Easy Regression Technique for $k$ -NN Classification Without Using Negative Pairs. . . . .                     | 17  |
| <i>Yutaro Shigeto, Masashi Shimbo, and Yuji Matsumoto</i>                                                                 |     |
| Deep Network Regularization via Bayesian Inference of Synaptic Connectivity. . . . .                                      | 30  |
| <i>Harris Partaourides and Sotirios P. Chatzis</i>                                                                        |     |
| Adaptive One-Class Support Vector Machine for Damage Detection in Structural Health Monitoring. . . . .                   | 42  |
| <i>Ali Anaissi, Nguyen Lu Dang Khoa, Samir Mustapha, Mehrisadat Makki Alamdari, Ali Braytee, Yang Wang, and Fang Chen</i> |     |
| A Classification Model for Diverse and Noisy Labelers . . . . .                                                           | 58  |
| <i>Hao-En Sung, Cheng-Kuan Chen, Han Xiao, and Shou-De Lin</i>                                                            |     |
| Automatic Discovery of Common and Idiosyncratic Latent Effects in Multilevel Regression . . . . .                         | 70  |
| <i>Sk Minhazul Islam and Arunvava Banerjee</i>                                                                            |     |
| A Deep Neural Network for Pairwise Classification: Enabling Feature Conjunctions and Ensuring Symmetry . . . . .          | 83  |
| <i>Kyohei Atarashi, Satoshi Oyama, Masahito Kurihara, and Kazune Furudo</i>                                               |     |
| Feature Ranking of Large, Robust, and Weighted Clustering Result . . . . .                                                | 96  |
| <i>Mirka Saarela, Joonas Hämäläinen, and Tommi Kärkkäinen</i>                                                             |     |
| Purchase Signatures of Retail Customers . . . . .                                                                         | 110 |
| <i>Clement Gautrais, René Quiniou, Peggy Cellier, Thomas Guyet, and Alexandre Termier</i>                                 |     |
| Volatility Adaptive Classifier System. . . . .                                                                            | 122 |
| <i>Ruolin Jia, Yun Sing Koh, and Gillian Dobbie</i>                                                                       |     |

|                                                                                                              |     |
|--------------------------------------------------------------------------------------------------------------|-----|
| Distributed Representations for Words on Tables . . . . .                                                    | 135 |
| <i>Minoru Yoshida, Kazuyuki Matsumoto, and Kenji Kita</i>                                                    |     |
| Link Prediction for Isolated Nodes in Heterogeneous Network<br>by Topic-Based Co-clustering. . . . .         | 147 |
| <i>Katsufumi Tomobe, Masafumi Oyamada, and Shinji Nakadai</i>                                                |     |
| Predicting Destinations from Partial Trajectories Using Recurrent<br>Neural Network . . . . .                | 160 |
| <i>Yuki Endo, Kyosuke Nishida, Hiroyuki Toda, and Hiroshi Sawada</i>                                         |     |
| Preventing Inadvertent Information Disclosures via Automatic<br>Security Policies . . . . .                  | 173 |
| <i>Tanya Goyal, Sanket Mehta, and Balaji Vasan Srinivasan</i>                                                |     |
| Personalized Deep Learning for Tag Recommendation. . . . .                                                   | 186 |
| <i>Hanh T.H. Nguyen, Martin Wistuba, Josif Grabocka,<br/>Lucas Rego Drumond, and Lars Schmidt-Thieme</i>     |     |
| Information-Theoretic Non-redundant Subspace Clustering . . . . .                                            | 198 |
| <i>Nina Hubig and Claudia Plant</i>                                                                          |     |
| Cost Matters: A New Example-Dependent Cost-Sensitive Logistic<br>Regression Model . . . . .                  | 210 |
| <i>Nikou Günnemann and Jürgen Pfeffer</i>                                                                    |     |
| <b>Social Network and Graph Mining</b>                                                                       |     |
| Beyond Assortativity: Proclivity Index for Attributed Networks (ProNE) . . . .                               | 225 |
| <i>Reihaneh Rabbany, Dhivya Eswaran, Artur W. Dubrawski,<br/>and Christos Faloutsos</i>                      |     |
| Hierarchical Mixed Neural Network for Joint Representation Learning<br>of Social-Attribute Network . . . . . | 238 |
| <i>Weizheng Chen, Jinpeng Wang, Zhuoxuan Jiang, Yan Zhang,<br/>and Xiaoming Li</i>                           |     |
| Cost-Effective Viral Marketing in the Latency Aware Independent<br>Cascade Model . . . . .                   | 251 |
| <i>Robert Gwadera and Grigorios Loukides</i>                                                                 |     |
| DSBPR: Dual Similarity Bayesian Personalized Ranking . . . . .                                               | 266 |
| <i>Longfei Shi, Bin Wu, Jing Zheng, Chuan Shi, and Mengxin Li</i>                                            |     |

|                                                                                                                                        |     |
|----------------------------------------------------------------------------------------------------------------------------------------|-----|
| Usage Based Tag Enhancement of Images . . . . .                                                                                        | 278 |
| <i>Balaji Vasan Srinivasan, Noman Ahmed Sheikh, Roshan Kumar,<br/>Saurabh Verma, and Niloy Ganguly</i>                                 |     |
| Edge Role Discovery via Higher-Order Structures . . . . .                                                                              | 291 |
| <i>Nesreen K. Ahmed, Ryan A. Rossi, Theodore L. Willke, and Rong Zhou</i>                                                              |     |
| Efficient Bi-level Variable Selection and Application to Estimation<br>of Multiple Covariance Matrices . . . . .                       | 304 |
| <i>Duy Nhat Phan, Hoai An Le Thi, and Dinh Tao Pham</i>                                                                                |     |
| Entity Set Expansion with Meta Path in Knowledge Graph . . . . .                                                                       | 317 |
| <i>Yuyan Zheng, Chuan Shi, Xiaohuan Cao, Xiaoli Li, and Bin Wu</i>                                                                     |     |
| Using Network Flows to Identify Users Sharing Extremist Content<br>on Social Media . . . . .                                           | 330 |
| <i>Yifang Wei and Lisa Singh</i>                                                                                                       |     |
| MC3: A Multi-class Consensus Classification Framework . . . . .                                                                        | 343 |
| <i>Tanmoy Chakraborty, Des Chandhok, and V.S. Subrahmanian</i>                                                                         |     |
| Monte Carlo Based Incremental PageRank on Evolving Graphs . . . . .                                                                    | 356 |
| <i>Qun Liao, ShuangShuang Jiang, Min Yu, Yulu Yang, and Tao Li</i>                                                                     |     |
| Joint Weighted Nonnegative Matrix Factorization for Mining<br>Attributed Graphs . . . . .                                              | 368 |
| <i>Zhichao Huang, Yunming Ye, Xutao Li, Feng Liu, and Huajie Chen</i>                                                                  |     |
| Predicting Happiness State Based on Emotion Representative Mining<br>in Online Social Networks . . . . .                               | 381 |
| <i>Xiao Zhang, Wenzhong Li, Hong Huang, Cam-Tu Nguyen, Xu Chen,<br/>Xiaoliang Wang, and Sanglu Lu</i>                                  |     |
| Exploring Celebrities on Inferring User Geolocation in Twitter . . . . .                                                               | 395 |
| <i>Mohammad Ebrahimi, Elaheh ShafieiBavani, Raymond Wong,<br/>and Fang Chen</i>                                                        |     |
| Do Rumors Diffuse Differently from Non-rumors? A Systematically<br>Empirical Analysis in Sina Weibo for Rumor Identification . . . . . | 407 |
| <i>Yahui Liu, Xiaolong Jin, Huawei Shen, and Xueqi Cheng</i>                                                                           |     |
| Investigating the Dynamics of Religious Conflicts by Mining Public<br>Opinions on Social Media . . . . .                               | 421 |
| <i>Swati Agarwal and Ashish Sureka</i>                                                                                                 |     |

|                                                                                                                 |     |
|-----------------------------------------------------------------------------------------------------------------|-----|
| Mining High-Utility Itemsets with Both Positive and Negative<br>Unit Profits from Uncertain Databases . . . . . | 434 |
| <i>Wensheng Gan, Jerry Chun-Wei Lin, Philippe Fournier-Viger,<br/>Han-Chieh Chao, and Vincent S. Tseng</i>      |     |
| Sparse Stochastic Inference with Regularization . . . . .                                                       | 447 |
| <i>Tung Doan and Khoat Than</i>                                                                                 |     |
| Exploring Check-in Data to Infer Social Ties in Location Based<br>Social Networks . . . . .                     | 460 |
| <i>Gunarto Sindoro Njoo, Min-Chia Kao, Kuo-Wei Hsu,<br/>and Wen-Chih Peng</i>                                   |     |
| Scalable Twitter User Clustering Approach Boosted<br>by Personalized PageRank . . . . .                         | 472 |
| <i>Anup Naik, Hideyuki Maeda, Vibhor Kanojia, and Sumio Fujita</i>                                              |     |
| An Enhanced Markov Clustering Algorithm Based on <i>Physarum</i> . . . . .                                      | 486 |
| <i>Mingxin Liang, Chao Gao, Xianghua Li, and Zili Zhang</i>                                                     |     |
| Exploiting Geographical Location for Team Formation in Social<br>Coding Sites. . . . .                          | 499 |
| <i>Yuqiang Han, Yao Wan, Liang Chen, Guandong Xu, and Jian Wu</i>                                               |     |
| Weighted Simplicial Complex: A Novel Approach for Predicting Small<br>Group Evolution . . . . .                 | 511 |
| <i>Ankit Sharma, Terrence J. Moore, Ananthram Swami,<br/>and Jaideep Srivastava</i>                             |     |
| A P-LSTM Neural Network for Sentiment Classification . . . . .                                                  | 524 |
| <i>Chi Lu, Heyan Huang, Ping Jian, Dan Wang, and Yi-Di Guo</i>                                                  |     |
| Learning What Matters – Sampling Interesting Patterns . . . . .                                                 | 534 |
| <i>Vladimir Dzyuba and Matthijs van Leeuwen</i>                                                                 |     |
| PNE: Label Embedding Enhanced Network Embedding . . . . .                                                       | 547 |
| <i>Weizheng Chen, Xianling Mao, Xiangyu Li, Yan Zhang, and Xiaoming Li</i>                                      |     |
| Improving Temporal Record Linkage Using Regression Classification . . . . .                                     | 561 |
| <i>Yichen Hu, Qing Wang, Dinusha Vatsalan, and Peter Christen</i>                                               |     |
| Community Detection in Graph Streams by Pruning Zombie Nodes . . . . .                                          | 574 |
| <i>Yue Ding, Ling Huang, Chang-Dong Wang, and Dong Huang</i>                                                    |     |
| Bilingual Lexicon Extraction from Comparable Corpora Based<br>on Closed Concepts Mining . . . . .               | 586 |
| <i>Mohamed Chebel, Chiraz Latiri, and Eric Gaussier</i>                                                         |     |

|                                                                                     |     |
|-------------------------------------------------------------------------------------|-----|
| Collective Geographical Embedding for Geolocating<br>Social Network Users . . . . . | 599 |
| <i>Fengjiao Wang, Chun-Ta Lu, Yongzhi Qu, and Philip S. Yu</i>                      |     |

### **Privacy-Preserving Mining and Security/Risk Applications**

|                                                                                                                                          |     |
|------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Partitioning-Based Mechanisms Under Personalized Differential Privacy . . . .                                                            | 615 |
| <i>Haoran Li, Li Xiong, Zhanglong Ji, and Xiaoqian Jiang</i>                                                                             |     |
| Efficient Cryptanalysis of Bloom Filters for Privacy-Preserving<br>Record Linkage . . . . .                                              | 628 |
| <i>Peter Christen, Rainer Schnell, Dinusha Vatsalan,<br/>and Thilina Ranbaduge</i>                                                       |     |
| Energy-Based Localized Anomaly Detection in Video Surveillance . . . . .                                                                 | 641 |
| <i>Hung Vu, Tu Dinh Nguyen, Anthony Travers, Svetha Venkatesh,<br/>and Dinh Phung</i>                                                    |     |
| A Fast Fourier Transform-Coupled Machine Learning-Based Ensemble<br>Model for Disease Risk Prediction Using a Real-Life Dataset. . . . . | 654 |
| <i>Raid Lafta, Ji Zhang, Xiaohui Tao, Yan Li, Wessam Abbas,<br/>Yonglong Luo, Fulong Chen, and Vincent S. Tseng</i>                      |     |
| Assessing Death Risk of Patients with Cardiovascular Disease<br>from Long-Term Electrocardiogram Streams Summarization. . . . .          | 671 |
| <i>Shenda Hong, Meng Wu, Jinbo Zhang, and Hongyan Li</i>                                                                                 |     |

### **Spatio-Temporal and Sequential Data Mining**

|                                                                                                      |     |
|------------------------------------------------------------------------------------------------------|-----|
| On the Robustness of Decision Tree Learning Under Label Noise. . . . .                               | 685 |
| <i>Aritra Ghosh, Naresh Manwani, and P.S. Sastry</i>                                                 |     |
| Relevance-Based Evaluation Metrics for Multi-class Imbalanced Domains . . .                          | 698 |
| <i>Paula Branco, Luís Torgo, and Rita P. Ribeiro</i>                                                 |     |
| Location Prediction Through Activity Purpose: Integrating Temporal<br>and Sequential Models. . . . . | 711 |
| <i>Dongliang Liao, Yuan Zhong, and Jing Li</i>                                                       |     |
| Modeling Temporal Behavior of Awards Effect on Viewership of Movies . . .                            | 724 |
| <i>Basmah Altaf, Faisal Kamiran, and Xiangliang Zhang</i>                                            |     |
| A <i>Physarum</i> -Inspired Ant Colony Optimization for Community Mining. . . .                      | 737 |
| <i>Mingxin Liang, Chao Gao, Xianghua Li, and Zili Zhang</i>                                          |     |

|                                                                                                      |            |
|------------------------------------------------------------------------------------------------------|------------|
| A Novel Diversity Measure for Understanding Movie Ranks in Movie<br>Collaboration Networks . . . . . | 750        |
| <i>Manqing Ma, Wei Pang, Lan Huang, and Zhe Wang</i>                                                 |            |
| Local-to-Global Unsupervised Anomaly Detection from Temporal Data . . . . .                          | 762        |
| <i>Seif-Eddine Benkabou, Khalid Benabdeslem, and Bruno Canitia</i>                                   |            |
| Mining Temporal Fluctuating Patterns . . . . .                                                       | 773        |
| <i>Shan-Yun Teng, Cheng-Kuan Ou, and Kun-Ta Chuang</i>                                               |            |
| Marked Temporal Dynamics Modeling Based on Recurrent<br>Neural Network . . . . .                     | 786        |
| <i>Yongqing Wang, Shenghua Liu, Huawei Shen, Jinhua Gao,<br/>and Xueqi Cheng</i>                     |            |
| Mining of Location-Based Social Networks for Spatio-Temporal<br>Social Influence . . . . .           | 799        |
| <i>Yu-Ting Wen, Yi Yuan Fan, and Wen-Chih Peng</i>                                                   |            |
| Multi-perspective Hierarchical Dirichlet Process for Geographical<br>Topic Modeling . . . . .        | 811        |
| <i>Yuan He, Cheng Wang, and Changjun Jiang</i>                                                       |            |
| Enumerating Non-redundant Association Rules Using Satisfiability . . . . .                           | 824        |
| <i>Abdelhamid Boudane, Said Jabbour, Lakhdar Sais, and Yakoub Salhi</i>                              |            |
| <b>Author Index . . . . .</b>                                                                        | <b>837</b> |

## Contents – Part II

### Clustering and Anomaly Detection

|                                                                                                         |    |
|---------------------------------------------------------------------------------------------------------|----|
| A Targeted Retraining Scheme of Unsupervised Word Embeddings<br>for Specific Supervised Tasks . . . . . | 3  |
| <i>Pengda Qin, Weiran Xu, and Jun Guo</i>                                                               |    |
| A Neural Joint Model for Extracting Bacteria and Their Locations . . . . .                              | 15 |
| <i>Fei Li, Meishan Zhang, Guohong Fu, and Donghong Ji</i>                                               |    |
| Advanced Computation of Sparse Precision Matrices for Big Data . . . . .                                | 27 |
| <i>Abdelkader Baggag, Halima Bensmail, and Jaideep Srivastava</i>                                       |    |
| Accurate Recognition of the Current Activity in the Presence<br>of Multiple Activities. . . . .         | 39 |
| <i>Weihao Cheng, Sarah Erfani, Rui Zhang, and Ramamohanarao Kotagiri</i>                                |    |
| Modeling Information Sharing Behavior on Q&A Forums . . . . .                                           | 51 |
| <i>Biru Cui, Shanchieh Jay Yang, and Christophan M. Homan</i>                                           |    |
| Effective Multiclass Transfer for Hypothesis Transfer Learning. . . . .                                 | 64 |
| <i>Shuang Ao, Xiang Li, and Charles X. Ling</i>                                                         |    |
| Clustering Based on Dominant Set and Cluster Expansion . . . . .                                        | 76 |
| <i>Jian Hou and Weixue Liu</i>                                                                          |    |

### Recommender Systems

|                                                                                                       |     |
|-------------------------------------------------------------------------------------------------------|-----|
| Friend Recommendation Considering Preference Coverage<br>in Location-Based Social Networks . . . . .  | 91  |
| <i>Fei Yu, Nan Che, Zhijun Li, Kai Li, and Shouxu Jiang</i>                                           |     |
| Contrast Pattern Based Collaborative Behavior Recommendation<br>for Life Improvement . . . . .        | 106 |
| <i>Yan Chen, Margot Lisa-Jing Yann, Heidar Davoudi, Joy Choi,<br/>Aijun An, and Zhen Mei</i>          |     |
| Exploiting Location Significance and User Authority for Point-of-Interest<br>Recommendation . . . . . | 119 |
| <i>Yonghong Yu, Hao Wang, Shuanzhu Sun, and Yang Gao</i>                                              |     |
| Personalized Ranking Recommendation via Integrating<br>Multiple Feedbacks . . . . .                   | 131 |
| <i>Jian Liu, Chuan Shi, Binbin Hu, Shenghua Liu, and Philip S. Yu</i>                                 |     |



|                                                                                                                      |     |
|----------------------------------------------------------------------------------------------------------------------|-----|
| Fairness Aware Recommendations on Behance . . . . .                                                                  | 144 |
| <i>Natwar Modani, Deepali Jain, Ujjawal Soni, Gaurav Kumar Gupta,<br/>and Palak Agarwal</i>                          |     |
| A Performance Evaluation Model for Taxi Cruising Path Recommendation<br>System . . . . .                             | 156 |
| <i>Huimin Lv, Fang Fang, Yishi Zhao, Yuanyuan Liu, and Zhongwen Luo</i>                                              |     |
| MaP2R: A Personalized Maximum Probability Route Recommendation<br>Method Using GPS Trajectories . . . . .            | 168 |
| <i>Ge Cui and Xin Wang</i>                                                                                           |     |
| <b>Feature Selection</b>                                                                                             |     |
| SNE: Signed Network Embedding. . . . .                                                                               | 183 |
| <i>Shuhan Yuan, Xintao Wu, and Yang Xiang</i>                                                                        |     |
| mHUIMiner: A Fast High Utility Itemset Mining Algorithm<br>for Sparse Datasets . . . . .                             | 196 |
| <i>Alex Yuxuan Peng, Yun Sing Koh, and Patricia Riddle</i>                                                           |     |
| Partial Tree-Edit Distance: A Solution to the Default Class Problem<br>in Pattern-Based Tree Classification. . . . . | 208 |
| <i>Maciej Piernik and Tadeusz Morzy</i>                                                                              |     |
| A Domain-Agnostic Approach to Spam-URL Detection via Redirects . . . . .                                             | 220 |
| <i>Heeyoung Kwon, Mirza Basim Baig, and Leman Akoglu</i>                                                             |     |
| Automatic and Effective Mining of Coevolving Online Activities . . . . .                                             | 233 |
| <i>Thinh Minh Do, Yasuko Matsubara, and Yasushi Sakurai</i>                                                          |     |
| Keeping Priors in Streaming Bayesian Learning . . . . .                                                              | 247 |
| <i>Anh Nguyen Duc, Ngo Van Linh, Anh Nguyen Kim, and Khoat Than</i>                                                  |     |
| <b>Text and Opinion Mining</b>                                                                                       |     |
| Efficient Training of Adaptive Regularization of Weight Vectors<br>for Semi-structured Text . . . . .                | 261 |
| <i>Tomoya Iwakura</i>                                                                                                |     |
| Behavior-Based Location Recommendation on Location-Based<br>Social Networks . . . . .                                | 273 |
| <i>Seyyed Mohammadreza Rahimi, Xin Wang, and Behrouz Far</i>                                                         |     |

|                                                                                                                                        |     |
|----------------------------------------------------------------------------------------------------------------------------------------|-----|
| Integer Linear Programming for Pattern Set Mining;<br>with an Application to Tiling . . . . .                                          | 286 |
| <i>Abdelkader Ouali, Albrecht Zimmermann, Samir Loudni, Yahia Lebbah,<br/>Bruno Cremilleux, Patrice Boizumault, and Lakhdar Loukil</i> |     |
| Secured Privacy Preserving Data Aggregation with Semi-honest Servers . . . .                                                           | 300 |
| <i>Zhigang Lu and Hong Shen</i>                                                                                                        |     |
| Efficient Pedestrian Detection in the Low Resolution via Sparse<br>Representation with Sparse Support Regression. . . . .              | 313 |
| <i>Wenhua Fang, Jun Chen, and Ruimin Hu</i>                                                                                            |     |
| Multi-task Representation Learning for Enhanced Emotion Categorization<br>in Short Text . . . . .                                      | 324 |
| <i>Anirban Sen, Manjira Sinha, Sandya Mannarswamy, and Shourya Roy</i>                                                                 |     |
| Fine-Grained Emotion Detection in Contact Center Chat Utterances . . . . .                                                             | 337 |
| <i>Shreshtha Mundra, Anirban Sen, Manjira Sinha, Sandya Mannarswamy,<br/>Sandipan Dandapat, and Shourya Roy</i>                        |     |
| Dependency-Tree Based Convolutional Neural Networks<br>for Aspect Term Extraction . . . . .                                            | 350 |
| <i>Hai Ye, Zichao Yan, Zhunchen Luo, and Wenhan Chao</i>                                                                               |     |
| Topic Modeling over Short Texts by Incorporating Word Embeddings . . . . .                                                             | 363 |
| <i>Jipeng Qiang, Ping Chen, Tong Wang, and Xindong Wu</i>                                                                              |     |
| Mining Drug Properties for Decision Support in Dental Clinics . . . . .                                                                | 375 |
| <i>Wee Pheng Goh, Xiaohui Tao, Ji Zhang, and Jianming Yong</i>                                                                         |     |
| PURE: A Novel Tripartite Model for Review Sentiment Analysis<br>and Recommendation . . . . .                                           | 388 |
| <i>Yue Xue, Liutong Xu, Hai Huang, and Yao Cheng</i>                                                                                   |     |

## Clustering and Matrix Factorization

|                                                                            |     |
|----------------------------------------------------------------------------|-----|
| Multi-View Matrix Completion for Clustering with Side Information. . . . . | 403 |
| <i>Peng Zhao, Yuan Jiang, and Zhi-Hua Zhou</i>                             |     |
| Weighted NMF-Based Multiple Sparse Views Clustering for Web Items . . . .  | 416 |
| <i>Xiaolong Gong, Fuwei Wang, and Linpeng Huang</i>                        |     |
| Parallel Visual Assessment of Cluster Tendency on GPU. . . . .             | 429 |
| <i>Tao Meng and Bo Yuan</i>                                                |     |
| Clustering Complex Data Represented as Propositional Formulas . . . . .    | 441 |
| <i>Abdelhamid Boudane, Said Jabbour, Lakhdar Sais, and Yakoub Salhi</i>    |     |

|                                              |     |
|----------------------------------------------|-----|
| Deep Bayesian Matrix Factorization . . . . . | 453 |
| <i>Sotirios P. Chatzis</i>                   |     |

**Dynamic, Stream Data Mining**

|                                                                                                             |     |
|-------------------------------------------------------------------------------------------------------------|-----|
| Mining Competitive Pairs Hidden in Co-location Patterns from Dynamic Spatial Databases . . . . .            | 467 |
| <i>Junli Lu, Lizhen Wang, Yuan Fang, and Momo Li</i>                                                        |     |
| Utility Aware Clustering for Publishing Transactional Data . . . . .                                        | 481 |
| <i>Michael Bewong, Jixue Liu, Lin Liu, and Jiuyong Li</i>                                                   |     |
| Self-tuning Filers — Overload Prediction and Preventive Tuning Using Pruned Random Forest . . . . .         | 495 |
| <i>Kumar Dheenadayalan, Gopalakrishnan Srinivasaraghavan, and V.N. Muralidhara</i>                          |     |
| A Centrality-Based Local-First Approach for Analyzing Overlapping Communities in Dynamic Networks . . . . . | 508 |
| <i>Ximan Chen, Heli Sun, Hongxia Du, Jianbin Huang, and Ke Liu</i>                                          |     |
| Web-Scale Personalized Real-Time Recommender System on Suumo . . . . .                                      | 521 |
| <i>Shiyingxue Li, Shimpei Nomura, Yohei Kikuta, and Kazuma Arino</i>                                        |     |
| Modeling Contextual Changes in User Behaviour in Fashion e-Commerce . . .                                   | 539 |
| <i>Ashay Tamhane, Sagar Arora, and Deepak Warriar</i>                                                       |     |
| Weighted Ensemble Classification of Multi-label Data Streams . . . . .                                      | 551 |
| <i>Lulu Wang, Hong Shen, and Hui Tian</i>                                                                   |     |

**Novel Models and Algorithms**

|                                                                                                                          |     |
|--------------------------------------------------------------------------------------------------------------------------|-----|
| Improving One-Class Collaborative Filtering with Manifold Regularization by Data-driven Feature Representation . . . . . | 565 |
| <i>Yen-Chieh Lien and Pu-Jen Cheng</i>                                                                                   |     |
| Stable Bayesian Optimization . . . . .                                                                                   | 578 |
| <i>Thanh Dai Nguyen, Sunil Gupta, Santu Rana, and Svetha Venkatesh</i>                                                   |     |
| An Exponential Time-Aware Recommendation Model for Mobile Notification Services . . . . .                                | 592 |
| <i>Chenglin Zeng, Laizhong Cui, and Zhi Wang</i>                                                                         |     |
| Discovering Periodic Patterns in Non-uniform Temporal Databases . . . . .                                                | 604 |
| <i>R. Uday Kiran, J.N. Venkatesh, Philippe Fournier-Viger, Masashi Toyoda, P. Krishna Reddy, and Masaru Kitsuregawa</i>  |     |

|                                                                                               |     |
|-----------------------------------------------------------------------------------------------|-----|
| Discovering Both Explicit and Implicit Similarities for Cross-Domain Recommendation . . . . . | 618 |
| <i>Quan Do, Wei Liu, and Fang Chen</i>                                                        |     |
| Mining Recurrent Patterns in a Dynamic Attributed Graph . . . . .                             | 631 |
| <i>Zhi Cheng, Frédéric Flouvat, and Nazha Selmaoui-Folcher</i>                                |     |
| SS-FIM: Single Scan for Frequent Itemsets Mining<br>in Transactional Databases . . . . .      | 644 |
| <i>Youssef Djenouri, Marco Comuzzi, and Djamel Djenouri</i>                                   |     |
| Multi-view Regularized Gaussian Processes . . . . .                                           | 655 |
| <i>Qiuyang Liu and Shiliang Sun</i>                                                           |     |
| A Neural Network Model for Semi-supervised Review<br>Aspect Identification . . . . .          | 668 |
| <i>Ying Ding, Changlong Yu, and Jing Jiang</i>                                                |     |

## Behavioral Data Mining

|                                                                                                                                 |     |
|---------------------------------------------------------------------------------------------------------------------------------|-----|
| Unsupervised Embedding for Latent Similarity by Modeling Heterogeneous<br>MOOC Data. . . . .                                    | 683 |
| <i>Zhuoxuan Jiang, Shanshan Feng, Weizheng Chen, Guangtao Wang,<br/>and Xiaoming Li</i>                                         |     |
| Matrix-Based Method for Inferring Variable Labels Using Outlines<br>of Data in Data Jackets . . . . .                           | 696 |
| <i>Teruaki Hayashi and Yukio Ohsawa</i>                                                                                         |     |
| Integrating Reviews into Personalized Ranking for Cold Start<br>Recommendation . . . . .                                        | 708 |
| <i>Guang-Neng Hu and Xin-Yu Dai</i>                                                                                             |     |
| Taste or Addiction?: Using Play Logs to Infer Song Selection Motivation . . .                                                   | 721 |
| <i>Kosetsu Tsukuda and Masataka Goto</i>                                                                                        |     |
| Understanding Drivers' Safety by Fusing Large Scale Vehicle Recorder<br>Dataset and Heterogeneous Circumstantial Data . . . . . | 734 |
| <i>Daisaku Yokoyama, Masashi Toyoda, and Masaru Kitsuregawa</i>                                                                 |     |

## Graph Clustering and Community Detection

|                                                                     |     |
|---------------------------------------------------------------------|-----|
| Query-oriented Graph Clustering. . . . .                            | 749 |
| <i>Li-Yen Kuo, Chung-Kuang Chou, and Ming-Syan Chen</i>             |     |
| CCCG: Clique Conversion Ratio Driven Clustering of Graphs . . . . . | 762 |
| <i>Prathyush Sambaturu and Kamalakar Karlapalem</i>                 |     |

|                                                                                                                                    |     |
|------------------------------------------------------------------------------------------------------------------------------------|-----|
| Mining Cohesive Clusters with Interpretations in Labeled Graphs . . . . .                                                          | 774 |
| <i>Hongxia Du, Heli Sun, Jianbin Huang, Zhongbin Sun, Liang He,<br/>and Hong Cheng</i>                                             |     |
| A SAT-Based Framework for Overlapping Community Detection<br>in Networks . . . . .                                                 | 786 |
| <i>Said Jabbour, Nizar Mhadhbi, Badran Raddaoui, and Lakhdar Sais</i>                                                              |     |
| <b>Dimensionality Reduction</b>                                                                                                    |     |
| Denoising Autoencoder as an Effective Dimensionality Reduction<br>and Clustering of Text Data . . . . .                            | 801 |
| <i>Milad Leyli-Abadi, Lazhar Labiod, and Mohamed Nadif</i>                                                                         |     |
| Gradable Adjective Embedding for Commonsense Knowledge . . . . .                                                                   | 814 |
| <i>Kyungjae Lee, Hyunsouk Cho, and Seung-won Hwang</i>                                                                             |     |
| Combining Dimensionality Reduction with Random Forests for Multi-label<br>Classification Under Interactivity Constraints . . . . . | 828 |
| <i>Noureddine-Yassine Nair-Benrekia, Pascale Kuntz, and Frank Meyer</i>                                                            |     |
| A Generalized Model for Multidimensional Intransitivity . . . . .                                                                  | 840 |
| <i>Jiuding Duan, Jiye Li, Yukino Baba, and Hisashi Kashima</i>                                                                     |     |
| <b>Author Index</b> . . . . .                                                                                                      | 853 |