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EDB'16

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General Chairs
Jinho Kim, Young-Kuk Kim, James Geller

Editor
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Program Chairs
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Message from EDB 2016 General Chairs

On behalf of the conference committee of EDB 2016, it is our pleasure to welcome you to Jeju Island, South Korea, for the Sixth International Conference on Emerging Databases: Technologies, Applications, and Theory.

EDB is an annual international forum for exchanging ideas and information on challenges, research results, and practical experience on a variety of emerging database fields. Since the First EDB conference was successfully held in 2009, the EDB series of conferences has become a leading international conference hosted by Korean Institute of Information Scientists and Engineers (KIISE) Database Society of Korea. Such success was possible because of strong supports from authors, participants, and sponsors.

This year event of EDB is held in Jeju Island, South Korea, which is a very beautiful place, known as Honeymoon Island. There are many places in Jeju Island which are unique and breathtaking and there are also many spots related to Korean dramas and movies leading Korean Wave. Because of these, Jeju Island became the place which both domestic and foreign tourists want to visit the most.

We acknowledge generous support from our sponsors. Their sponsorship was a critical help to make EDB 2016 successful. Our sincere thanks go to many organizations which helped our effort. We also wish to extend our thanks to ACM and KIISE.

Many people contributed to make EDB 2016 a great success. Our thanks go to all of them: Honorary Chairs, Sun-Hwa Hahn, Young-Duk Lee, and Bong-Hee Hong; Organizing Chairs, Wookey Lee, Xiaoyong Du, and Atsuyuki Morishima; Program Chairs, Young-Ho Park, Wonik Choi, and Carson Leung; Publicity Chairs, Sang-Wook Kim, Sanghyun Park, Jae-Soo Yoo, and Mukesh Mohania; Publication Chairs, Yang-Sae Moon, Woong-Ki Loh, Sael Lee, and Robert Wrembel; Workshop Chairs, Min Song, Jun-Ki Min, and Wendy Hui Wang; DBSW Chairs, Jae-Gil Lee, U Kang, and Aoying Zhou; Tutorial Chairs, Jae-Woo Kang, Sung-Won Jung, and Yasushi Sakurai; Finance Chairs, Duk-Hwan Kim, Ha-Joo Song, Yong-Tae Woo, and Chaokun Wang; Registration Chairs, Young-Koo Lee, Jinseok Chae, and Alfredo Cuzzocrea; Local Arrangement Chairs, Han-Joon Kim, Aziz Nasridinov, and Beom Jong You; Web Chairs, Chul-Yeon Kim and Nidhi Arora. Our thanks also go to the KIISE (Korea Institute of Information Scientists and Engineers) Database Society of Korea, which has organized EDB 2016.

Finally, our sincere thanks go to all the participants of EDB 2016 who made the greatest contribution for the EDB 2016 conference.

Welcome and enjoy the conference at a beautiful romantic island!

Jinho Kim, *Kangwon National University, South Korea*
Young-Kuk Kim, *Chungnam National University, South Korea*
James Geller, *New Jersey Institute of Technology, USA*

Message from EDB 2016 Program Chairs

The International Conference on Emerging Databases (EDB) is an annual forum for exploring technologies, applications, and theory of emerging database fields. It encourages academic and industrial interaction and promotes collaborative research in emerging databases by bringing together academics, government and industry professionals to discuss recent progress and challenges in technologies, applications, and theory of the fields. Moreover, EDB also serves as a platform for theoreticians and practitioners to exchange their original research ideas on academic or industrial aspects, present their new findings or innovative results on theoretical or practical aspects, share their experiences on integrating new technologies into products and applications, discuss their work on performing novel applications in real-life situations, describe their development and operations of challenging database related systems, and identify unsolved challenges.

The Sixth International Conference on Emerging Databases: Technologies, Applications, and Theory (EDB 2016) focuses on data science, data mining, big data management and analytics, which are popular areas in computer science and other related fields. The conference provides opportunities for researchers and practitioners to exchange current issues, challenges, new technologies, and practical experiences. EDB 2016 is held at Jeju KAL Hotel in Jeju Island, South Korea, on October 17-19, 2016, and is hosted by KIISE (Korean Institute of Information Scientists and Engineers) Database Society of Korea.

For EDB 2016, we have recruited many international experts in emerging database and data science to join our team of international program committee. As a result, our Program Committee consists of professionals from different parts of the world including Australia, Belgium, Canada, Chile, China, France, Hong Kong, India, Italy, Japan, Qatar, Singapore, South Korea, Switzerland, Taiwan, Thailand, USA, and Vietnam. This committee has done an excellent job in completing the single-blind review and on-line double-blind debate processes. The paper selection process was thorough and competitive. Each submission was refereed by at least two reviewers. Among these submissions, we accepted 7 high-quality submissions of 8-10 pages each as full research papers (i.e., an acceptance rate of around 13%) addressing technical issues, solutions, and technologies in emerging database and data science fields. To allow more researchers to express their opinions and vision on exploring new concepts and research directions, we also include 12 additional research papers and several posters. This year, we have a rich program—which includes keynote speeches, invited talks, research paper presentations, tutorials, and poster sessions—spanning over three days (October 17-19, 2016).

EDB 2016 would not have been possible without the help and effort of many people and organizations. We thank our host (KIISE Database Society of Korea) and sponsors (2e Consulting, Korea Database Agency, and Nara System), and many other organizations, for their support of this conference. We also express our thanks to EDB 2016 Organizing Committee members, especially the Honorary Chairs (S.-H. Hahn, B.-H. Hong, and Y.-D. Lee), General Chairs (J. Geller, J. Kim, and Y.-K. Kim), and Organizing Chairs (X. Du, W. Lee, and A. Morishima) for their valuable advice and suggestions towards the conference. We are grateful to EDB 2016 Program Committee members for their professionalism and dedication in the process of judging the contributions of papers and producing constructive comments to the authors. We also thank authors and non-author participants of this conference. Last but not least, we thank the ACM staff (especially, C. Rodkin and A. Lacson) for their help in publishing the current proceedings in the ACM International Conference Proceeding Series (ICPS) by ACM Press.

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Yujin Lim (University of Suwon, South Korea)

EDB 2016 Speakers

Keynote Speakers

- **Il-Yeol Song,** PhD (Louisiana State University, USA)
  Professor
  College of Computing & Informatics
  Drexel University
  Philadelphia, PA, USA

- **X. Sean Wang,** PhD (University of Southern California, USA)
  Dean & Professor
  Scool of Computer Science
  Fudan University
  Shanghai, China

Invited Speakers

- **Alfredo Cuzzocrea,** PhD (University of Calabria, Italy)
  Associate Professor
  Computer Science Engineering
  University of Trieste
  Trieste TS, Italy

- **Masatoshi Yoshikawa,** PhD (Kyoto University, Japan)
  Professor
  Department of Information Science
  Kyoto University
  Kyoto, Japan

Tutorial Speakers

- **Hwanjo Yu,** PhD (University of Illinois at Urbana-Champaign, USA)
  Professor
  Department of Computer Science and Engineering
  Pohang University of Science and Technology (*POSTECH*)
  Pohang, South Korea

- **Suha Kwak,** PhD (POSTECH, South Korea)
  Assistant Professor
  Department of Information and Communication Engineering
  Daegu Gyeongbuk Institute of Science and Technology (*DGIST*)
  Daegu, South Korea

EDB 2016 Keynote Speech

Smart Aging

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Aging is a growing social problem in the developed world and especially in Korea. According to the UN data (http://data.un.org/Data.aspx?q=aged+over+60&d=PopDiv&f=variableID%3a33), the rate of aging in Korea is the highest in the world. The UN data estimates that 25% of the Korean population by 2022 and 33% by 2034 will be aged 60 or over. Furthermore, doctors in Korea are overworked and spend less time with patients than any other country. Hence, it is critically important to mitigate the effects of aging, improve elderly people's life, and improve overall quality of healthcare environments. Smart aging addresses those challenges by intelligently utilizing modern biomedical, digital healthcare, computing, and communication technologies. In this talk, I will first cover needs and scope of smart aging, followed by the recent paradigm shifts in healthcare due to advances in healthcare and big data technologies. I will then review various world-wide research & development (R&D) projects in smart aging areas. The coverage includes various wearable sensors, NIH's funding policy and funded R&D projects on aging, innovative aging-related R&D projects being developed, and super computer Watson-based smart aging projects. I will conclude my talk with suggestions that can be adopted by Korea.

Il-Yeol Song is professor in the College of Computing and Informatics of Drexel University. He served as Deputy Director of NSF-sponsored research center on Visual & Decision Informatics (CVDI) between 2012-2014. He is an ACM Distinguished Scientist and an ER Fellow. He is the recipient of 2015 Peter P. Chen Award in Conceptual Modeling. Dr. Song published over 200 peer-reviewed papers in data management areas. He is a co-Editor-in-Chief of *Journal of Computing Science and Engineering* (*JCSE*). He won the Best Paper Award in the IEEE CIBCB 2004. He won four teaching awards from Drexel, including the most prestigious Lindback Distinguished Teaching Award. Dr. Song served as the Steering Committee chair of the ER conference between 2010-2012. He delivered a keynote speech on big data at the First Asia-Pacific iSchool Conference in 2014, ACM SAC 2015 conference, and ER 2015 Conference.

EDB 2016 Keynote Speech

Exploratory Data Analysis Applications and Techniques

X. Sean Wang
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The increasing availability of various data and the relevant analysis tools provides a great opportunity for society. At this stage of development, human involvement in data analysis is inevitable, as human judgement is still a necessary ingredient in many of the analysis tasks. This talk focuses on the need of such exploratory analysis in different applications, and techniques used in interactive, exploratory data analysis, especially on query optimization challenges and potential solutions.

X. Sean Wang is Professor and Dean at the School of Compute Science, Fudan University, Shanghai, China. He received his PhD degree in Computer Science from the University of Southern California, Los Angeles, CA, USA, in 1992. Before joining Fudan University in 2011, he was the Dorothean Chair Professor in Computer Science at the University of Vermont, Burlington, VT, USA, and between 2009-2011, he served as a Program Director at the National Science Foundation, USA. He has published widely in the general area of databases and information security, and was a recipient of the US National Science Foundation Research Initiation and CAREER awards. His research interests include database systems and information security. He served as the general chair of IEEE ICDE 2011 held in Washington, DC, USA and ACM CIKM 2014 in Shanghai, China, and in various other roles at international conferences and journals.

EDB 2016 Invited Talk

Big Data Compression Paradigms for Supporting Efficient and Scalable Data-Intensive IoT Frameworks

Alfredo Cuzzocrea
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This talk focuses on big data compression paradigms within reference data-intensive IoT frameworks, which are currently recognized as one of the emerging scientific in a rich interdisciplinary field that comprises service-oriented infrastructures, Cloud computing, big data management and analytics. Basically, big data compression techniques allow taming the complexity of big data management tasks within such frameworks, hence beneficially influencing all the other activities, perhaps delivered as services in a reference Cloud architecture. Inspired by these considerations, we provide an overview on noticeable state-of-the-art big data compression techniques, and depict future research directions on the investigated scientific topic to be considered during future years.

Alfredo Cuzzocrea is currently Associate Professor in Computer Science Engineering at the DIA Department, University of Trieste, Italy. He is also habilitated as Full Professor in Computer Science Engineering by the French National Scientific Habilitation of the National Council of Universities. He holds several Visiting Professor positions worldwide (Europe, USA, Asia, Australia) and roles in international scientific societies, steering committees for international conferences, and international panels. He also actively contributes the research community by covering a large collection of roles in top-quality conferences and journals. His research interests mostly focus on big data management, processing, and analytics.

EDB 2016 Invited Talk

Multi-user Routing with Confluence

Masatoshi Yoshikawa
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The recent increase in attention to ride-sharing applications demonstrates the importance of routing algorithms for multiple users who obtain benefits from the confluence that is, traveling together on all or part of their routes. This new type of multi-user routing is valuable in various practical applications, such as ride sharing, delivery routing, and pedestrian navigation. We formulate the MCR (Mutually beneficial Confluent Routing) as a new combinatorial optimization problem on road networks. In the MCR, every user has his/her own source and destination; confluences of user routes occur so that users can mutually benefit from traveling together on the confluences. The MCR is more general and complex than single vehicle routing problems, ride-sharing problems, and the Steiner tree problem. We propose exact and efficient algorithms for the MCR for the setting of two or three users. The setting is reasonable for various practical applications. For the case where users have a single common destination, our formulation is general enough to express each user's benefit (or cost) of confluence for every combination of users. Hence, the formulation can represent a wide range of applications and subsumes almost all formulations proposed in the literature. We establish an efficient exact method for the formulation. Our experimental results obtained on large-scale road networks reveal that our method is efficient in practical settings.

Masatoshi Yoshikawa received the BE, ME, and Dr Eng degrees from the Department of Information Science, Kyoto University, in 1980, 1982, and 1985, respectively. From 1985 to 1993, he was with Kyoto Sangyo University. In 1993, he joined the Nara Institute of Science and Technology as an associate professor of the Graduate School of Information Science. From June 2002 to March 2006, he served as a professor at Nagoya University. Since April 2006, he has been a professor at Kyoto University. His general research interests are in the area of databases. His current research interests include multi-user routing algorithms and services, theory and practice of privacy protection, and medical data mining. He is a member of the ACM, IPSJ, and IEICE. He is a member of the program committee for VLDB 2017.

EDB 2016 Tutorial

Recommender System

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Recommender systems have high demands in industry, yet building an effective recommender system is technically challenging as it involves issues in both the state-of-the-art machine learning and big data processing. I will start this tutorial by introducing basic concepts and techniques in recommender systems such as random walk and matrix factorization. Then, I will present practical issues such as novel recommendation, when to recommend, scalable matrix factorization, and cold-start recommendation using deep learning.

Hwanjo Yu received his PhD in Computer Science at the University of Illinois at Urbana-Champaign at June 2004 under the supervision of Prof. Jiawei Han. From July 2004 to January 2008, he had been an assistant professor at the University of Iowa. He is now an associate professor at Pohang University of Science and Technology (POSTECH). He developed influential algorithms and systems in the areas of big data and machine learning, including (1) algorithms for classifying without negative data (PEBL, SVMC), (2) privacy-preserving SVM algorithms (PP-SVM), (3) SVM-JAVA: an educational java open source for SVM, (4) RefMed: the relevance feedback search engine for PubMed, and (5) TurboGraph: a fast parallel graph engine handling billion-scale graphs in a single PC. His methods and algorithms were published in prestigious journals and conferences including ACM KDD, AAAI, IJCAI, ACM SIGMOD, IEEE ICDE, IEEE ICDM, ACM CIKM, etc.

EDB 2016 Tutorial

Weakly-Supervised Approaches for Visual Recognition

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Many state-of-the-art techniques in machine learning and computer vision rely on large-scale supervised learning, where the supervision is typically given by manual annotations. For example, learning a classifier demands class labels manually annotated for each of training data. However, when desired output of such techniques is high-dimensional and structured (e.g., graph or segmentation), collecting large-scale annotations is significantly labor-intensive, and it is difficult to maintain good quality of annotations in terms of both accuracy and consistency. One way to alleviate this issue is weakly supervised learning, where one exploits weaker but readily-available annotations to learn a model that predicts the higher-level outputs. The key determinant of success in weakly supervised approaches is then how well they fill the gap between annotation and prediction. This tutorial will provide an overview of recent weakly-supervised approaches with a focus on visual recognition as main application, and presents future directions for weakly supervised learning.

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