VLDB2014
40th International Conference on Very Large Data Bases, Hangzhou, China

Proceedings of the VLDB Endowment

Volume 7, No. 2 – October 2013

Proceedings of the 40th International Conference on Very Large Data Bases, Hangzhou, China

PVLDB – Proceedings of the VLDB Endowment

Volume 7, No. 2, October 2013.

The 40th International Conference on Very Large Data Bases, Hangzhou, China.

Copyright 2013 VLDB Endowment

Volume 7, Number 2, October 2013: VLDB 2014

Pages ii - ix and 97 - 132

ISSN 2150-8097

Additional copies only online at: portal.acm.org, arxiv.org/corr, and www.vldb.org

TABLE OF CONTENTS

VLDB 2014 ORGANIZATION AND REVIEW BOARD

Honorary Chair

Yunhe Pan, Chinese Academy of Engineering

General Chairs

Chun Chen, Zhejiang University

Sharad Mehrotra, University of California, Irvine

Program Chairs and Editors-in-Chief of PVLDB 7

H. V. Jagadish, University of Michigan

Aoying Zhou, East Normal University, China

Research and Innovative Systems Tracks Associate Editors

Shivnath Babu, Duke University

Lei Chen, Hong Kong University of Science and Technology

Graham Cormode, University of Warwick

Bin Cui, Peking University, China

Wynne Hsu, NUS

Martin Kersten, CWI

Donald Kossman, ETH

Elke Rundensteiner, WPI

Kyuseok Shim, Seoul National University

Wang-Chiew Tan, University of California, Santa Cruz

Letizia Tanca, Poli Milano

Jeffrey Yu, Chinese University of Hong Kong

Experiments and Analysis Track Associate Editors

Gao Cong, Nanyang Technology University

Jens Dittrich, Saarland

Visions Track Associate Editor

Zachary Ives, University of Pennsylvania

Industrial and Applications Track Associate Editors

Umeshwar Dayal, HP

C. Mohan, IBM

Ge Yu, Northeastern University, China

Demonstration Chairs

Mong-Li Lee, NUS

Feifei Li, University of Utah

Sunil Prabhakar, Purdue

Tutorial Chairs

Xiaoyong Du, Renmin University

Murat Kantarcioglu, University of Texas, Dallas

Divesh Srivastava, AT&T Labs

Workshop Chairs

Anastasia Ailamaki, EPFL

Kaushik Chakrabarti, Microsoft

Panel Chairs

Hakan Hacigumus, NEC Labs

Jignesh Patel, University of Wisconsin

Xiaoyang Sean Wang, Fudan University

Research Track Review Board

Sibel Adali, Rensselear Polytechnic Institute

Foto Afrati, NTU Athens

Yanif Ahmad, JHU

Jose Luis Ambite, ISI - USC

Walid Aref, Purdue University

Claudia Bauzer Medeiros, University of Campinas

Srikanta Bedathur, IIIT Delhi

Michael Benedikt, Oxford University

Sonia Bergamaschi, Universita Modena

Laure Berti-Equille, IRD, France

Leopoldo Bertossi, Carleton University, Ottawa

Subhash Bhalla, University of Aizu, Japan

Peter Boncz, CWI

Angela Bonifati, University of Lille 1

Rajesh Bordawekar, IBM Watson Research Center

Omar Boucelma, Aix-Marseille University

Nico Bruno, Microsoft Research

Andrea Cali, University of London, Birkbeck College

Malu Castellanos, HP Labs

Badrish Chandramouli, Microsoft Research

Adriane Chapman, Mitre

Gang Chen, Zhejiang University

Yi Chen, New Jersey Institute of Technology

James Cheng, CUHK

Reynold Cheng, University of Hong Kong

Brian Cooper, Google, USA

Philippe Cudré-Mauroux, University of Fribourg

Carlo Curino, MIT

Gautam Das, UT Arlington and QCRI

Sudipto Das, Microsoft Research

Anish Das Sarma

Atish Das Sarma, eBay Research Labs

Khuzaima Daudjee, University of Waterloo

Antonios Deligiannakis, Technical University of Crete

Daniel Deutch, Ben Gurion University

Yanlei Diao, University of Massachusetts Amherst

Xin (Luna) Dong, Google, USA

Sameh Elnikety, Microsoft Research

Mohamed Eltabakh, Worcester Polytechnic Institute

Ihab F. Ilyas, QCRI

Hakan Ferhatosmanoglu, Bilkent University

Ada Wai-Chee Fu, Chinese University of Hong Kong

Minos Garofalakis, Technical University of Crete

Wolfgang Gatterbauer, Carnegie Mellon University

Tingjian Ge, University of Massachussets, Lowell

Buğra Gedik, Bilkent University

Rainer Gemulla, Max-Plack-Institut Saarbr點ken

Gabriel Ghinita, University of Massachusetts Boston

Parke Godfrey, York University

Lukasz Golab, University of Waterloo

Sergio Greco, University of Calabria

Le Gruenwald, University of Oklahoma

Giovanna Guerrini, Universita Genova
Krishna Gummadi, MPI-SWS
Rahul Gupta, Google Research
Rajeev Gupta, IBM Research
Shyam Gupta, IIT Delhi
Marios Hadjielefhteriou, AT&T labs
Wook-Shin Han, KNU, Korea
Kuno Harumi, HP Labs
Bingsheng He, NTU Singapore
Sven Helmer, Free University of Bozen-Bolzano
Jan Hidders, TUDelft
Wei Hong, Cisco System Inc.
Katja Hose, Aalborg University
Zi Huang, University of Queensland
Jeong-Hyon Hwang, SUNY - Albany
Seung-won Hwang, POSTECH, Korea
Stratos Idreos, CWI
Yoshiharu Ishikawa, Nagoya University
Zachary Ives, University of Pennsylvania
Ricardo Jimenez-Peris, Technical University of Madrid
Cheqing Jin, East China Normal University
Ruoming Jin, Kent State University
Alekh Jindal, Saarland University/MIT
Ryan Johnson, University of Toronto
Dmitri V Kalashnikov, UC Irvine
Panos Kalnis, KAUST, Saudi Arabia
Ben Kao, Hong Kong University
Panagiotis Karras, Rutgers University
Yiping Ke, Institute of High Performance Computing
Bettina Kemme, McGill University
Daniel Kifer, PSU
Benny Kimelfeld, IBM
Hideaki Kimura, Microsoft Jim Gray Systems Lab
George Kollios, Boston University
Christian König, Microsoft Research
Tim Kraska, Brown University
Laks V. S. Lakshmanan, University of British Columbia
Mounia Lalmas, Yahoo Inc.
Mong-Li Lee, National University of Singapore
Wolfgang Lehner, Technische University Dresden
Justin Levandoski, Microsoft Research
Chengkai Li, The University of Texas at Arlington
Cuiping Li, Renmin University of China
Feifei Li, University of Utah
Guoliang Li, Tsinghua University
Jianzhong Li, Harbin Institute of Technology
Yunyao Li, IBM Almaden
Zhanhuai Li, Northwestern Polytechnical University
Dan Lin, Missouri S&T, USA
Xuemin Lin, University of New South Wales
Bin Liu, NEC Labs America
Ziyang Liu, NEC Labs America
Eric Lo, The Hong Kong Polytechnic University
Qiong Luo, HKUST
Shuai Ma, Beihang University
Ashwin Machanavajjhala, Duke University
Brad Malin, Duke University
Nikos Mamoulis, University of Hong Kong
Stefan Manegold, CWI
Murali Mani, University of Michigan
Ioana Manolescu, INRIA, France
Amélie Marian, Rutgers University
Volker Markl, TU Berlin
Marta Mattoso, Federal University of Rio de Janeiro
Frank McSherry, Microsoft
Alexandra Meliou, Umass Amherst
Marco Mesiti, University of Milano
Dan Miranker, The University of Texas at Austin
Mohamed Mokbel, University of Minnesota
Bongki Moon, Seoul National University
Yasuhiko Morimoto, Hiroshima University
Mirella Moro, Universidade Federal de Minas Gerais
Kyriakos Mouratidis, SMU, Singapore
Karin Murthy, IBM India
Arnab Nandi, Ohio State University
Wolfgang Nejdl, University of Hannover

Thomas Neumann, Technology University Munchen
Boris Novikov, St Petersburg University
Dan Olteanu, Oxford University
Gultekin Ozsoyoglu, Case Western Reserve University
Tamer Ozsu, University of Waterloo
Esther Pacitti, University of Montpellier
Themis Palpanas, University of Trento
Ippokratis Pandis, IBM Almaden
Stelios Paparizos, Microsoft Research
Aditya Parameswaran, Stanford University
Srinivasan Parthasarathy, The Ohio State University
Jignesh Patel, University of Wisconsin
Andrew Pavlo, Brown University
Peter Pietzuch, Imperial College London
Neoklis Polyzotis, University of California - Santa Cruz
Cecilia M. Procopiuc, AT&T Labs
Li Qian, University of Michigan
Jorge Quiané-Ruiz, QCRI
Elisa Quintarelli, Politecnico di Milano
Maya Ramanath, IIT Delhi
Louiqa Raschid, University of Maryland
Vibhar Rastogi, Yahoo
Matthias Renz, University of Munich
Kenneth Ross, Columbia University
Sourav S Bhowmick, NTU, Singapore
Dimitris Sacharidis, IMIS Athena, Greece
Kenneth Salem, Univesity of Waterloo
Maria Sapino, University of Torino
Kai-Uwe Sattler, TU Ilmenau
Monica Scannapieco, ISTAT
Bernhard Seeger, University of Marburg
Lidan Shou, Zhejiang University
Adam Silberstein, Trifacta
Lisa Singh, Georgetown University
Radu Sion, Stony Brook University
Yufei Tao, Chinese University of Hong Kong
Nesime Tatbul, ETH Zurich
Arash Termehchy, Oregon State University
Evimaria Terzi, University of Boston
Martin Theobald, Max Planck Institute, Germany
Srikanta Tirthapura, Iowa State University
Riccardo Torlone, Roma Tre University
Anthony Tung, National University of Singapore
Kostas Tzoumas, Technical University of Berlin
Sergei Vassilvitskii, Google Research
Marcos Vaz Salles, University of Copenhagen (DIKU)
Stratis Viglas, University of Edinburgh
Hoang Tam Vo, National University of Singapore
Daisy Zhe Wang, University of Florida
Haixun Wang, Microsoft Research Asia
Ke Wang, Simon Fraser University
Wei Wang, University of New South Wales
Xiaoling Wang, East China Normal University
Ingmar Weber, Yahoo
Raymond Chi Wing Wong, HKUST
Sai Wu, Zhejiang University
Yuqing Wu, Indiana University
Xiaokui Xiao, NTU
Dong Xin, Google
Jianliang Xu, Hong Kong Baptist University
Jun (Jim) Xu, Georgia Institute of Technology
Xifeng Yan, University of Santa Barbara
Xiaoyan Yang, Advanced Digital Science Center
Ke Yi, HKUST
Ge Yu, Northeastern University, China
Hwanjo Yu, POSTECH, Korea
Meihui Zhang, National University of Singapore
Wenjie Zhang, The University of New South Wales
Ying Zhang, The University of New South Wales
Zhenjie Zhang, Advanced Digital Science Center
Wenzhao Zhou, Georgetown University
Xiaofang Zhou, University of Queensland

PhD Workshop Chairs

Erich Neuhold, University of Vienna

Yunyao Li, IBM

Sponsorship Chairs

Mike Carey, University of California, Irvine

Lizhu Zhou, Tsinghua University

Local Organization Chair

Lidan Shou, Zhejiang University

Web Management Chair

Sai Wu, Zhejiang University

Conference and Registration Chairs

Ke Chen, Zhejiang University

Cuiping Li, Renmin University

Publicity Chairs

Vasilis Vassalos, AUEB, Greece

Dunlu Peng, USST, China

Proceedings Chairs

Li Xiong, Emory University

Cong Yu, Google Research

Treasury Chair

Li (Eric) Qian, University of Michigan

VLDB Endowment Liaison

Kyu-Young Whang, KAIST

PVLDB Managing Editor

Divesh Srivastava, AT&T Labs

PVLDB Information Director

Gerald Weber, University of Auckland

PVLDB Advisory Committee

Philip Bernstein, Michael Böhlen, Peter Buneman, Susan Davidson, Z. Meral Ozsoyoglu, S. Sudarshan, Gerhard Weikum

Logo Design

Guanmin Guo

LETTER FROM THE ASSOCIATE EDITORS

This is the second issue of Proceedings of the VLDB Endowment (PVLDB) Volume 6. We would like to give an overview on the Experiments and Analysis (E&A) Track of PVLDB. The E&A Track fosters papers that focus on the experimental evaluation of existing algorithms, data structures, and systems. The E&A Track is for papers where performance evaluation through analytical modeling, simulation, and/or experiments is the primary contribution. Specifically, the E&A track papers may fit in the following categories: (1) Experimental Surveys: papers that compare a wide spectrum of approaches to a problem and, through extensive experiments, provide a comprehensive perspective on the results available and how they compare to each other. (2) Result Verification: papers that verify or refute results published in the past and that, through a renewed performance evaluation, help to advance the state of the art. (3) Problem Analysis: papers that focus on relevant problems or phenomena and through analysis and/or experimentation provide insights on the nature or characteristics of these phenomena. Overall, the E&A track places a great emphasis on comprehensive and detailed performance evaluation, appropriate methodology, and a fair assessment of the strengths and weaknesses of ideas published in previous work. The scientific contribution of an E&A-track paper lies in providing new insights into the strengths and weaknesses of existing methods. We hope you will find papers in the E&A track inspiring and interesting, and we hope that you will continue to submit your work to our future issues.

We would like to thank the authors for their high-quality submissions and thank to our PC members and the PC chairs for their hard work in the review process.

Gao Cong, Nanyang Technological University

Jens Dittrich, Saarland University

Experiments and Analysis Track Associate Chairs, VLDB 2014