Lecture Notes in Computer Science 9990

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison
Lancaster University, Lancaster, UK
Takeo Kanade
Carnegie Mellon University, Pittsburgh, PA, USA
Josef Kittler
University of Surrey, Guildford, UK
Jon M. Kleinberg
Cornell University, Ithaca, NY, USA
Friedemann Mattern
ETH Zurich, Zurich, Switzerland
John C. Mitchell
Stanford University, Stanford, CA, USA
Moni Naor
Weizmann Institute of Science, Rehovot, Israel
C. Pandu Rangan
Indian Institute of Technology, Madras, India
Bernhard Steffen
TU Dortmund University, Dortmund, Germany
Demetri Terzopoulos
University of California, Los Angeles, CA, USA
Doug Tygar
University of California, Berkeley, CA, USA
Gerhard Weikum
Max Planck Institute for Informatics, Saarbrücken, Germany

More information about this series at http://www.springer.com/series/8851

Ngoc Thanh Nguyen · Ryszard Kowalczyk
Cezary Orłowski · Artur Ziółkowski (Eds.)

Transactions on Computational Collective Intelligence XXV

Springer

Editors-in-Chief

Ngoc Thanh Nguyen
Department of Information Systems
Wrocław University of Technology
Wroclaw
Poland

Ryszard Kowalczyk
Swinburne University of Technology
Hawthorn, VIC
Australia

Guest Editors

Cezary Orłowski
Gdansk School of Banking (WSB Gdańsk)
Gdańsk
Poland

Artur Ziółkowski
Gdansk School of Banking (WSB Gdańsk)
Gdańsk
Poland

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-662-53579-0 ISBN 978-3-662-53580-6 (eBook)
DOI 10.1007/978-3-662-53580-6

Library of Congress Control Number: 2016953315

© Springer-Verlag GmbH Germany 2016
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.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer-Verlag GmbH Germany
The registered company address is: Heidelberger Platz 3, 14197 Berlin, Germany

Transactions on Computational Collective Intelligence XXV

Preface

Modern agglomerations face the challenge of changes arising from the needs and requirements of their residents, and from either acceptance or rejection of the "smart cities" vision. The consideration of these requirements and the acceptance of the vision are a long-term process in which municipal decision-makers, city residents, and civic organizations work out a compromise, which is often the result of merit-based decisions by the authorities but can also result from political decisions on which the residents only have an indirect influence. Such a complex city system – seen from the perspective of the authorities, city residents, and organizations, and taking into account many decision-making processes that are hard to control and analyze – represents a complex environment for the implementation of information technology supporting city management processes.

Owing to the aforementioned considerations, the process of IT implementation represents a system of complex technology- and management-related mechanisms (more focused on management-related ones), whose pre-implementation analysis becomes crucial for building a successful strategy for the completion of such projects. Therefore, a relatively large amount of information is published on the functioning of cities in the context of their transformation to smart cities and on the technologies applied both in system design and implementation; experiences are also presented of cities that were, have been, or will be in some stage of such a transformation.

The set of papers presented here (prepared by the team) is part of the presentation of descriptions of such transformation processes. It is based on the experiences of the CAS design team (IBM Centre for Advanced Studies on Campus), making use of IBM IOC (Intelligent Operating Centre) consisting of six members (Cezary Orłowski, Tomasz Sitek, Artur Ziółkowski, Paweł Kapłański, Aleksander Orłowski, Witold Pokrzywnicki). The technology framework of smart cities systems (where IOC may be given as an example) shows the opportunities and constraints for the implementation of city processes. It also enables a broader model-based analytical view of city processes and the specific information technologies applied in order to model and implement these processes. Taking into account this form of presentation, the papers consider three perspectives of the design and implementation of smart cities systems.

The first perspective is the client perspective, i.e., of the city and its organizational processes and the possibilities of applying measurements to these processes. In the first paper, "High-Level Model for the Design of KPIs for Smart Cities Systems," two points of view are considered: a high-level view within which the city processes are discussed and confronted with measurements in the form of key performance indicators (KPIs) and a low-level one showing to what degree the available indicators may be applied to measure the city's processes. Within this perspective in the second paper, "Implementation of Business Processes in Smart Cities Technology," the model of the

city processes is presented and the authors' own measurements for assessing the maturity of these processes are suggested. Moreover, opportunities for enhancing the KPIs through creating integrated or dynamic KPIs are indicated. These two papers aim (a) at showing to what extent the present approaches based on KPIs may be applied in the design framework delivered by software developers and (b) at suggesting measurements for assessing the maturity of these processes.

The second perspective is the project perspective, on which two papers are presented. In the paper "Designing Aggregate KPIs as a Method of Implementing Decision-Making Processes in the Management of Smart Cities," a low-level view of the project in the context of management processes is described. The fourth paper, "Smart Cities System Design Method Based on Case Based Reasoning," illustrates an approach resulting from the need to treat both the development process management method and system implementation as components that may be used by any city. Both of these papers provide methodology-based support for the management and implementation processes of smart cities systems.

The third perspective is the provider's perspective. Here, two papers are presented that describe low-level and high-level approaches. In the fifth paper of the volume, "Model of an Integration Bus of Data and Ontologies of Smart Cities Processes," the high-level approach to using an ontology for supporting the construction of a high-level architecture is presented. The construction of such an architecture becomes necessary in the case of an agile approach to project management. The authors' experiences connected with use of agile methods show that the availability of an ontology of concepts (objects and processes, both development-related and management-related ones) significantly simplifies the design of sprints and the prioritizing of backlog tasks. In the sixth paper, "Ontology of the Design Pattern Language for Smart Cities Systems," the second low-level perspective, the significance of building an integration bus for a joint view of development processes, technology, and artifacts, as well as the products of the design and implementation of smart cities are described.

Additionally, we include two papers concerning the dynamic and semantic assessment of systems. In their contribution, Vo Thanh Vinh and Duong Tuan Anh propose two novel improvements for minimum description length-based semisupervised classification of time series: an improvement technique for the minimum description length-based stopping criterion and a refinement step to make the classifier more accurate. In the eighth paper by B. John Oommen, Richard Khour, and Aron Schmidt, the problem of text classification is explained using "anti"-Bayesian quantile statistics-based classifiers.

The papers presented are the result of shared projects on organizational solutions, carried out together with IBM, such as the 10-year period of collaboration within the Academic Initiative, Competence Centre and Centre for Advances Studies on Campus, and also research projects carried out at the Gdańsk University of Technology and CAS. During 2011–2015, the international research project Eureka E! 3266 (EURO-ENVIRON WEBAIR) "Managing Air Quality in Agglomerations with the Use of a www Server" was carried out. The Armaag Foundation, IBM, DGT, Gdańsk City Council, and the Marshall's Office in Gdańsk all took part in the project. The project objective was to create an IT system supporting decisions with regard to dust pollution

and noise in Gdańsk. Hence the project was addressed to City Council analytical units, which deal with the conditions of such decisions.

The second project was the PEOPLE MARIE CURIE ACTIONS project carried out within the International Research Staff Exchange Scheme called: FP7-PEOPLE-2009-IRSES "Smart Multipurpose Knowledge Administration Environment for Intelligent Decision Support Systems Development," and continued until the end of March 2015. The goal of the project was the development by the Australian partner (University of Newcastle) of an environment for the building of intelligent decision support systems based on SOEKS (Set of Experiences). The data/cases for the verification of the environment were provided by the partners, namely, the Gdańsk University of Technology and Vicomtech from Spain. In the schedule of the project, three verification cases had been envisaged, and one of them was the data concerning the design of a smart cities system for Gdańsk within the Eureka project.

The synergy of these two projects and the experience of many business partners collaborating in both projects, as well as the close cooperation between CAS and IBM Polska, created the conditions for such a comprehensive assessment of smart cities systems. The three perspectives presented in the work – i.e., that of the client of the city, the smart cities for the Gdańsk project, and the provider, CAS Gdańsk – close the first stage of experiences covering system design and implementation. The papers on this work (covering the three perspectives) were prepared so as to have a generic and component-specific dimension and may serve as guidelines in both the design and implementation of smart cities systems for a number of cities.

September 2016

Cezary Orłowski
Artur Ziółkowski

Transactions on Computational Collective Intelligence

This Springer journal focuses on research in applications of the computer-based methods of computational collective intelligence (CCI) and their applications in a wide range of fields such as the Semantic Web, social networks, and multi-agent systems. It aims to provide a forum for the presentation of scientific research and technological achievements accomplished by the international community.

The topics addressed by this journal include all solutions to real-life problems for which it is necessary to use computational collective intelligence technologies to achieve effective results. The emphasis of the papers published is on novel and original research and technological advancements. Special features on specific topics are welcome.

Editor-in-Chief

Ngoc Thanh Nguyen	Wroclaw University of Science and Technology, Poland

Co-Editor-in-Chief

Ryszard Kowalczyk	Swinburne University of Technology, Australia

Guest Editors

Cezary Orłowski	Gdansk School of Banking (WSB Gdańsk), Poland
Artur Ziółkowski	Gdansk School of Banking (WSB Gdańsk), Poland

Editorial Board

John Breslin	National University of Ireland, Galway, Ireland
Longbing Cao	University of Technology Sydney, Australia
Shi-Kuo Chang	University of Pittsburgh, USA
Oscar Cordon	European Centre for Soft Computing, Spain
Tzung-Pei Hong	National University of Kaohsiung, Taiwan
Gordan Jezic	University of Zagreb, Croatia
Piotr Jędrzejowicz	Gdynia Maritime University, Poland
Kang-Huyn Jo	University of Ulsan, Korea
Yiannis Kompatsiaris	Centre for Research and Technology Hellas, Greece
Jozef Korbicz	University of Zielona Gora, Poland
Hoai An Le Thi	Lorraine University, France
Pierre Lévy	University of Ottawa, Canada
Tokuro Matsuo	Yamagata University, Japan
Kazumi Nakamatsu	University of Hyogo, Japan
Toyoaki Nishida	Kyoto University, Japan

Manuel Núñez	Universidad Complutense de Madrid, Spain
Julian Padget	University of Bath, UK
Witold Pedrycz	University of Alberta, Canada
Debbie Richards	Macquarie University, Australia
Roman Słowiński	Poznan University of Technology, Poland
Edward Szczerbicki	University of Newcastle, Australia
Tadeusz Szuba	AGH University of Science and Technology, Poland
Kristinn R. Thorisson	Reykjavik University, Iceland
Gloria Phillips-Wren	Loyola University Maryland, USA
Sławomir Zadrożny	Institute of Research Systems, PAS, Poland
Bernadetta Maleszka	Assistant Editor, Wroclaw University of Science and Technology, Poland

Contents

High-Level Model for the Design of KPIs for Smart Cities Systems 1
Cezary Orłowski, Artur Ziółkowski, Aleksander Orłowski, Paweł Kapłański, Tomasz Sitek, and Witold Pokrzywnicki

Implementation of Business Processes in Smart Cities Technology 15
Cezary Orłowski, Artur Ziółkowski, Aleksander Orłowski, Paweł Kapłański, Tomasz Sitek, and Witold Pokrzywnicki

Designing Aggregate KPIs as a Method of Implementing Decision-Making Processes in the Management of Smart Cities 29
Cezary Orłowski, Artur Ziółkowski, Aleksander Orłowski, Paweł Kapłański, Tomasz Sitek, and Witold Pokrzywnicki

Smart Cities System Design Method Based on Case Based Reasoning 43
Cezary Orłowski, Artur Ziółkowski, Aleksander Orłowski, Paweł Kapłański, Tomasz Sitek, and Witold Pokrzywnicki

Model of an Integration Bus of Data and Ontologies of Smart Cities Processes 59
Cezary Orłowski, Artur Ziółkowski, Aleksander Orłowski, Paweł Kapłański, Tomasz Sitek, and Witold Pokrzywnicki

Ontology of the Design Pattern Language for Smart Cities Systems 76
Cezary Orłowski, Artur Ziółkowski, Aleksander Orłowski, Paweł Kapłański, Tomasz Sitek, and Witold Pokrzywnicki

Text Classification Using "Anti"-Bayesian Quantile Statistics-Based Classifiers 101
B. John Oommen, Richard Khoury, and Aron Schmidt

Two Novel Techniques to Improve MDL-Based Semi-Supervised Classification of Time Series 127
Vo Thanh Vinh and Duong Tuan Anh

Author Index 149