

Journal Subline

LNCS 3730

Journal on **Data Semantics IV**

Stefano Spaccapietra
Editor-in-Chief

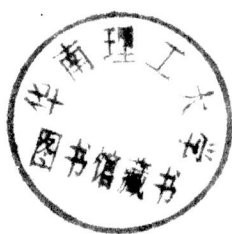


Springer

TP311.13

J86.3 Stefano Spaccapietra (Ed.)

Journal on Data Semantics IV



E200601361



Springer

Volume Editor

Stefano Spaccapietra

EPFL-IC-IIF-LBD, INJ 236 (Bâtiment INJ), Station 14

1015 Lausanne, Switzerland

E-mail: stefano.spaccapietra@epfl.ch

Library of Congress Control Number: 2005937594

CR Subject Classification (1998): H.2, H.3, I.2, H.4, C.2

ISSN 0302-9743

ISBN-10 3-540-31001-0 Springer Berlin Heidelberg New York

ISBN-13 978-3-540-31001-3 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springer.com

© Springer-Verlag Berlin Heidelberg 2005

Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper SPIN: 11603412 06/3142 5 4 3 2 1 0

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, 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, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

New York University, NY, USA

Doug Tygar

University of California, Berkeley, CA, USA

Moshe Y. Vardi

Rice University, Houston, TX, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

The LNCS Journal on Data Semantics

Computerized information handling has changed its focus from centralized data management systems to decentralized data exchange facilities. Modern distribution channels, such as high-speed Internet networks and wireless communication infrastructure, provide reliable technical support for data distribution and data access, materializing the new, popular idea that data may be available to anybody, anywhere, anytime. However, providing huge amounts of data on request often turns into a counterproductive service, making the data useless because of poor relevance or inappropriate level of detail. Semantic knowledge is the essential missing piece that allows the delivery of information that matches user requirements. Semantic agreement, in particular, is essential to meaningful data exchange.

Semantic issues have long been open issues in data and knowledge management. However, the boom in semantically poor technologies, such as the Web and XML, has boosted renewed interest in semantics. Conferences on the Semantic Web, for instance, attract crowds of participants, while ontologies on their own have become a hot and popular topic in the database and artificial intelligence communities.

Springer's *LNCS Journal on Data Semantics* aims at providing a highly visible dissemination channel for the most remarkable work that in one way or another addresses research and development on issues related to the semantics of data. The target domain ranges from theories supporting the formal definition of semantic content to innovative domain-specific application of semantic knowledge. This publication channel should be of the highest interest to researchers and advanced practitioners working on the Semantic Web, interoperability, mobile information services, data warehousing, knowledge representation and reasoning, conceptual database modeling, ontologies, and artificial intelligence.

Topics of relevance to this journal include:

- Semantic interoperability, semantic mediators
- Ontologies
- Ontology, schema and data integration, reconciliation and alignment
- Multiple representations, alternative representations
- Knowledge representation and reasoning
- Conceptualization and representation
- Multimodel and multiparadigm approaches
- Mappings, transformations, reverse engineering
- Metadata
- Conceptual data modeling
- Integrity description and handling
- Evolution and change
- Web semantics and semi-structured data
- Semantic caching
- Data warehousing and semantic data mining
- Spatial, temporal, multimedia and multimodal semantics

- Semantics in data visualization
- Semantic services for mobile users
- Supporting tools
- Applications of semantic-driven approaches

These topics are to be understood as specifically related to semantic issues. Contributions submitted to the journal and dealing with semantics of data will be considered even if they are not within the topics in the list.

While the physical appearance of the journal issues is like the books from the well-known Springer LNCS series, the mode of operation is that of a journal. Contributions can be freely submitted by authors and are reviewed by the Editorial Board. Contributions may also be invited, and nevertheless carefully reviewed, as in the case for issues that contain extended versions of the best papers from major conferences addressing data semantics issues. Special issues, focusing on a specific topic, are coordinated by guest editors once the proposal for a special issue is accepted by the Editorial Board. Finally, it is also possible that a journal issue be devoted to a single text.

The journal published its first volume in 2003 (LNCS 2800), its second volume at the beginning of 2005 (LNCS 3360), and its third volume in Summer 2005 (LNCS 3534). The first two volumes are special issues composed of selected extended versions of the best conference papers. The third volume is a special issue on “Semantic-Based Geographical Information Systems”, coordinated by guest editor Prof. Esteban Zimányi. This fourth volume is the first “normal” volume, consisting of spontaneous submissions on any of the topics of interest to the journal. Currently planned volumes include a special issue on emergent semantics.

The Editorial Board comprises one Editor-in-Chief (with overall responsibility) and several members. The Editor-in-Chief has a four-year mandate to run the journal. Members of the board have a three-year mandate. Mandates are renewable. More members may be added to the board as appropriate.

We are happy to welcome both readers and authors, and hope we will share this privileged contact for a long time.

Stefano Spaccapietra
Editor-in-Chief
<http://lbdwww.epfl.ch/e/Springer/>

JoDS Volume IV - Preface

This fourth JoDS volume is the outcome of the selection of papers spontaneously submitted to the journal, in particular in response to a Call for Papers issued on July 17, 2004. The call invited submissions on any topic that falls within the scope of the journal.

Altogether, 38 submissions were reviewed. After the first round of reviews, 24 submissions were asked to perform a major revision and resubmit. Most of these were actually resubmitted and went through a second round of reviews, with the same reviewers as allocated for the first round. Eventually, 10 papers were accepted for publication, after some last modifications suggested by the reviewers.

Accepted papers cover a wide range of topics, from traditional data semantics (information modeling, data model transformation, knowledge representation, data and schema integration) to the newest trends (multimedia, Semantic Web annotation, information extraction, and knowledge discovery).

A new Call for Papers is open at the moment for a volume to appear in 2006. We are looking forward to your contributions.

Stefano Spaccapietra
Editor-in-Chief

In Memoriam

Prof. Maurizio Panti

On July 3, 2005, at 9:45AM, Prof. Maurizio Panti, Head of the Department of Computer, Management and Automation Engineering at the Polytechnic University of Marche, passed away.

Approximately seven months earlier, he had been diagnosed with a late-stage aggressive cancer. In this brief period of illness, he never stopped his activities, showing devotion to his work and students and a strong will power that will be an example for all of us. He spent his final hours surrounded by family and friends.

Prof. Maurizio Panti was full professor of Information Systems and Data Bases. He promoted the growth of informatics both in academia, contributing to the foundation of the Informatics Institute, which then developed into the present department, and in the regional economic arena, also serving as a member in the Scientific and Technical Board for the Regional Information System.

His loss will be greatly felt by all those who knew and worked with him.

Prof. Hongjun Lu

Prof. Hongjun Lu was a world-renowned researcher who served the database community with dedication and distinction in various capacities over the years. He was a trustee of the VLDB Endowment, a member of the ACM SIGMOD Advisory Board (1998–2002), an associate editor of IEEE Transactions on Knowledge and Data Engineering (TKDE), Chair of the Steering Committee of the International Conference on Web-Age Information Management (WAIM), and Co-chair (1998–2001) and Chair (2001–2003) of the Steering Committee of Pacific-Asia Conference of Knowledge Discovery and Data Mining (PAKDD). In December 2004, the China Computer Federation Database Society honored him with a Contribution Award and, just recently, he was honored with this year's inaugural PAKDD Distinguished Contribution Award.

His passing is a great loss not only to the China Database Society but also to the International Database Society. He has made sustained and outstanding contributions to the international database research community as well as to database research.

Organization

External Reviewers

All Editorial Board members contributed reviews for the selection of the submissions. In addition, a number of colleagues helped us in this reviewing task. We would like to express here our gratitude for their cooperation and our warmest thanks for the job they did.

Bettina Berendt

Sonia Bergamaschi

Claudio Bettini

Mokrane Bouzeghoub

Anita Coleman

Jos De Bruin

Flavio De Paoli

Giovanni Denaro

Ying Ding

Gillian Dobbie

Anastasios D. Doulamis

Oleksandr Drutskyy

Birte Glimm

Sven Hartmann

Georges Hébrail

Martin Hepp

Jane Hunter

Mustafa Jarrar

Roland Kaschek

Evgeny Zolin

Yehuda Koren

Mong Li Lee

Lei Li

Xiaonan Lu

R. Manmatha

Andrea Maurino

Rym Mili

Moira Norrie

Axel Polleres

Helen Purchase

Brian Roark

Ingo Schmitt

Richard Smiraglia

Peter Spyns

Paolo Terenziani

Christelle Vangenot

Michalis Vazirgiannis

James Z. Wang

X. Sean Wang

JoDS Editorial Board

Carlo Batini, Università di Milano Bicocca, Italy

Tiziana Catarci, Università di Roma La Sapienza, Italy

Lois Delcambre, Portland State University, USA

David W. Embley, Brigham Young University, USA

Jerome Euzenat, INRIA Rhône-Alpes, France

Dieter Fensel, University of Innsbruck, Austria

Nicola Guarino, National Research Council, Italy

Jean-Luc Hainaut, FUNDP Namur, Belgium

Ian Horrocks, University of Manchester, UK

Larry Kerschberg, George Mason University, USA

Maurizio Lenzerini, Università di Roma La Sapienza, Italy

Tok Wang Ling, National University of Singapore, Singapore

Salvatore T. March, Vanderbilt University, USA

Robert Meersman, Vrije Universiteit Brussel (VUB), Belgium

John Mylopoulos, University of Toronto, Canada

Shamkant B. Navathe, Georgia Institute of Technology, USA

Antoni Olivé, Universitat Politècnica de Catalunya, Spain

José Palazzo M. de Oliveira, Universidade Federal do Rio Grande do Sul, Brazil

Christine Parent, Université de Lausanne, Switzerland

John Roddick, Flinders University, Australia

Klaus-Dieter Schewe, Massey University, New Zealand

Bernhard Thalheim, Brandenburg University of Technology, Germany

Yair Wand, University of British Columbia, Canada

Esteban Zimányi, Université Libre de Bruxelles (ULB), Belgium

Lecture Notes in Computer Science

For information about Vols. 1–3748

please contact your bookseller or Springer

Vol. 3860: D. Pointcheval (Ed.), Topics in Cryptology – CT-RSA 2006. XI, 365 pages. 2006.

Vol. 3850: R. Freund, G. Păun, G. Rozenberg, A. Salomaa (Eds.), Membrane Computing. IX, 371 pages. 2006.

Vol. 3838: A. Middeldorp, V. van Oostrom, F. van Raamsdonk, R. de Vrijer (Eds.), Processes, Terms and Cycles: Steps on the Road to Infinity. XVIII, 639 pages. 2005.

Vol. 3837: K. Cho, P. Jacquet (Eds.), Technologies for Advanced Heterogeneous Networks. IX, 307 pages. 2005.

Vol. 3835: G. Sutcliffe, A. Voronkov (Eds.), Logic for Programming, Artificial Intelligence, and Reasoning. XIV, 744 pages. 2005. (Sublibrary LNAI).

Vol. 3834: D. Feitelson, E. Frachtenberg, L. Rudolph, U. Schwiegelshohn (Eds.), Job Scheduling Strategies for Parallel Processing. VIII, 283 pages. 2005.

Vol. 3833: K.-J. Li, C. Vangenot (Eds.), Web and Wireless Geographical Information Systems. XI, 309 pages. 2005.

Vol. 3829: P. Pettersson, W. Yi (Eds.), Formal Modeling and Analysis of Timed Systems. IX, 305 pages. 2005.

Vol. 3828: X. Deng, Y. Ye (Eds.), Internet and Network Economics. XVII, 1106 pages. 2005.

Vol. 3827: X. Deng, D. Du (Eds.), Algorithms and Computation. XX, 1190 pages. 2005.

Vol. 3826: B. Benatallah, F. Casati, P. Traverso (Eds.), Service-Oriented Computing – ICSSOC 2005. XVIII, 597 pages. 2005.

Vol. 3824: L.T. Yang, M. Amamiya, Z. Liu, M. Guo, F.J. Rammig (Eds.), Embedded and Ubiquitous Computing – EUC 2005. XXIII, 1204 pages. 2005.

Vol. 3823: T. Enokido, L. Yan, B. Xiao, D. Kim, Y. Dai, L.T. Yang (Eds.), Embedded and Ubiquitous Computing – EUC 2005 Workshops. XXXII, 1317 pages. 2005.

Vol. 3822: D. Feng, D. Lin, M. Yung (Eds.), Information Security and Cryptology. XII, 420 pages. 2005.

Vol. 3821: R. Ramanujam, S. Sen (Eds.), FSTTCS 2005: Foundations of Software Technology and Theoretical Computer Science. XIV, 566 pages. 2005.

Vol. 3820: L.T. Yang, X. Zhou, W. Zhao, Z. Wu, Y. Zhu, M. Lin (Eds.), Embedded Software and Systems. XXVIII, 779 pages. 2005.

Vol. 3819: P. Van Hentenryck (Ed.), Practical Aspects of Declarative Languages. X, 231 pages. 2006.

Vol. 3818: S. Grumbach, L. Sui, V. Vianu (Eds.), Advances in Computer Science – ASIAN 2005. XIII, 294 pages. 2005.

Vol. 3816: G. Chakraborty (Ed.), Distributed Computing and Internet Technology. XXI, 606 pages. 2005.

Vol. 3815: E.A. Fox, E.J. Neuhold, P. Premssmit, V. Wongse (Eds.), Digital Libraries: Implementing Strategies and Sharing Experiences. XVII, 529 pages. 2005.

Vol. 3814: M. Maybury, O. Stock, W. Wahlster (Eds.), Intelligent Technologies for Interactive Entertainment. XV, 342 pages. 2005. (Sublibrary LNAI).

Vol. 3813: R. Molva, G. Tsudik, D. Westhoff (Eds.), Security and Privacy in Ad-hoc and Sensor Networks. VIII, 219 pages. 2005.

Vol. 3810: Y.G. Desmedt, H. Wang, Y. Mu, Y. Li (Eds.), Cryptology and Network Security. XI, 349 pages. 2005.

Vol. 3809: S. Zhang, R. Jarvis (Eds.), AI 2005: Advances in Artificial Intelligence. XXVII, 1344 pages. 2005. (Sublibrary LNAI).

Vol. 3808: C. Bento, A. Cardoso, G. Dias (Eds.), Progress in Artificial Intelligence. XVIII, 704 pages. 2005. (Sublibrary LNAI).

Vol. 3807: M. Dean, Y. Guo, W. Jun, R. Kaschek, S. Krishnaswamy, Z. Pan, Q.Z. Sheng (Eds.), Web Information Systems Engineering – WISE 2005 Workshops. XV, 275 pages. 2005.

Vol. 3806: A.H. H. Ngu, M. Kitsuregawa, E.J. Neuhold, J.-Y. Chung, Q.Z. Sheng (Eds.), Web Information Systems Engineering – WISE 2005. XXI, 771 pages. 2005.

Vol. 3805: G. Subsol (Ed.), Virtual Storytelling. XII, 289 pages. 2005.

Vol. 3804: G. Bebis, R. Boyle, D. Koracin, B. Parvin (Eds.), Advances in Visual Computing. XX, 755 pages. 2005.

Vol. 3803: S. Jajodia, C. Mazumdar (Eds.), Information Systems Security. XI, 342 pages. 2005.

Vol. 3802: Y. Hao, J. Liu, Y.-P. Wang, Y.-m. Cheung, H. Yin, L. Jiao, J. Ma, Y.-C. Jiao (Eds.), Computational Intelligence and Security, Part II. XLII, 1166 pages. 2005. (Sublibrary LNAI).

Vol. 3801: Y. Hao, J. Liu, Y.-P. Wang, Y.-m. Cheung, H. Yin, L. Jiao, J. Ma, Y.-C. Jiao (Eds.), Computational Intelligence and Security, Part I. XLI, 1122 pages. 2005. (Sublibrary LNAI).

Vol. 3799: M. A. Rodríguez, I.F. Cruz, S. Levashkin, M.J. Egenhofer (Eds.), GeoSpatial Semantics. X, 259 pages. 2005.

Vol. 3798: A. Dearnley, S. Eisenbach (Eds.), Component Deployment. X, 197 pages. 2005.

Vol. 3797: S. Maitra, C. E. V. Madhavan, R. Venkatesan (Eds.), Progress in Cryptology – INDOCRYPT 2005. XIV, 417 pages. 2005.

Vol. 3796: N.P. Smart (Ed.), Cryptography and Coding. XI, 461 pages. 2005.

- Vol. 3795: H. Zhuge, G.C. Fox (Eds.), Grid and Cooperative Computing - GCC 2005. XXI, 1203 pages. 2005.
- Vol. 3794: X. Jia, J. Wu, Y. He (Eds.), Mobile Ad-hoc and Sensor Networks. XX, 1136 pages. 2005.
- Vol. 3793: T. Conte, N. Navarro, W.-m. W. Hwu, M. Valero, T. Ungerer (Eds.), High Performance Embedded Architectures and Compilers. XIII, 317 pages. 2005.
- Vol. 3792: I. Richardson, P. Abrahamsson, R. Messnarz (Eds.), Software Process Improvement. VIII, 215 pages. 2005.
- Vol. 3791: A. Adi, S. Stoutenburg, S. Tabet (Eds.), Rules and Rule Markup Languages for the Semantic Web. X, 225 pages. 2005.
- Vol. 3790: G. Alonso (Ed.), Middleware 2005. XIII, 443 pages. 2005.
- Vol. 3789: A. Gelbukh, Á. de Albornoz, H. Terashima-Marín (Eds.), MICAI 2005: Advances in Artificial Intelligence. XXVI, 1198 pages. 2005. (Sublibrary LNAI).
- Vol. 3788: B. Roy (Ed.), Advances in Cryptology - ASIACRYPT 2005. XIV, 703 pages. 2005.
- Vol. 3787: D. Kratsch (Ed.), Graph-Theoretic Concepts in Computer Science. XIV, 470 pages. 2005.
- Vol. 3785: K.-K. Lau, R. Banach (Eds.), Formal Methods and Software Engineering. XIV, 496 pages. 2005.
- Vol. 3784: J. Tao, T. Tan, R.W. Picard (Eds.), Affective Computing and Intelligent Interaction. XIX, 1008 pages. 2005.
- Vol. 3783: S. Qing, W. Mao, J. Lopez, G. Wang (Eds.), Information and Communications Security. XIV, 492 pages. 2005.
- Vol. 3781: S.Z. Li, Z. Sun, T. Tan, S. Pankanti, G. Chollet, D. Zhang (Eds.), Advances in Biometric Person Authentication. XI, 250 pages. 2005.
- Vol. 3780: K. Yi (Ed.), Programming Languages and Systems. XI, 435 pages. 2005.
- Vol. 3779: H. Jin, D. Reed, W. Jiang (Eds.), Network and Parallel Computing. XV, 513 pages. 2005.
- Vol. 3778: C. Atkinson, C. Bunse, H.-G. Gross, C. Peper (Eds.), Component-Based Software Development for Embedded Systems. VIII, 345 pages. 2005.
- Vol. 3777: O.B. Lupanov, O.M. Kasim-Zade, A.V. Chaskin, K. Steinhöfel (Eds.), Stochastic Algorithms: Foundations and Applications. VIII, 239 pages. 2005.
- Vol. 3776: S.K. Pal, S. Bandyopadhyay, S. Biswas (Eds.), Pattern Recognition and Machine Intelligence. XXIV, 808 pages. 2005.
- Vol. 3775: J. Schönwälder, J. Serrat (Eds.), Ambient Networks. XIII, 281 pages. 2005.
- Vol. 3774: G. Bierman, C. Koch (Eds.), Database Programming Languages. X, 295 pages. 2005.
- Vol. 3773: A. Sanfeliu, M.L. Cortés (Eds.), Progress in Pattern Recognition, Image Analysis and Applications. XX, 1094 pages. 2005.
- Vol. 3772: M. Consens, G. Navarro (Eds.), String Processing and Information Retrieval. XIV, 406 pages. 2005.
- Vol. 3771: J.M.T. Romijn, G.P. Smith, J. van de Pol (Eds.), Integrated Formal Methods. XI, 407 pages. 2005.
- Vol. 3770: J. Akoka, S.W. Liddle, I.-Y. Song, M. Bertolotto, I. Comyn-Wattiau, W.-J. van den Heuvel, M. Kolp, J. Trujillo, C. Kop, H.C. Mayr (Eds.), Perspectives in Conceptual Modeling. XXII, 476 pages. 2005.
- Vol. 3769: D.A. Bader, M. Parashar, V. Sridhar, V.K. Prasanna (Eds.), High Performance Computing - HiPC 2005. XXVIII, 550 pages. 2005.
- Vol. 3768: Y.-S. Ho, H.J. Kim (Eds.), Advances in Multimedia Information Processing - PCM 2005, Part II. XXVIII, 1088 pages. 2005.
- Vol. 3767: Y.-S. Ho, H.J. Kim (Eds.), Advances in Multimedia Information Processing - PCM 2005, Part I. XXVIII, 1022 pages. 2005.
- Vol. 3766: N. Sebe, M.S. Lew, T.S. Huang (Eds.), Computer Vision in Human-Computer Interaction. X, 231 pages. 2005.
- Vol. 3765: Y. Liu, T. Jiang, C. Zhang (Eds.), Computer Vision for Biomedical Image Applications. X, 563 pages. 2005.
- Vol. 3764: S. Tixeuil, T. Herman (Eds.), Self-Stabilizing Systems. VIII, 229 pages. 2005.
- Vol. 3762: R. Meersman, Z. Tari, P. Herrero (Eds.), On the Move to Meaningful Internet Systems 2005: OTM 2005 Workshops. XXXI, 1228 pages. 2005.
- Vol. 3761: R. Meersman, Z. Tari (Eds.), On the Move to Meaningful Internet Systems 2005: CoopIS, DOA, and ODBASE, Part II. XXVII, 653 pages. 2005.
- Vol. 3760: R. Meersman, Z. Tari (Eds.), On the Move to Meaningful Internet Systems 2005: CoopIS, DOA, and ODBASE, Part I. XXVII, 921 pages. 2005.
- Vol. 3759: G. Chen, Y. Pan, M. Guo, J. Lu (Eds.), Parallel and Distributed Processing and Applications - ISPA 2005 Workshops. XIII, 669 pages. 2005.
- Vol. 3758: Y. Pan, D.-x. Chen, M. Guo, J. Cao, J.J. Dongarra (Eds.), Parallel and Distributed Processing and Applications. XXIII, 1162 pages. 2005.
- Vol. 3757: A. Rangarajan, B. Vemuri, A.L. Yuille (Eds.), Energy Minimization Methods in Computer Vision and Pattern Recognition. XII, 666 pages. 2005.
- Vol. 3756: J. Cao, W. Nejdl, M. Xu (Eds.), Advanced Parallel Processing Technologies. XIV, 526 pages. 2005.
- Vol. 3754: J. Dalmiau Royo, G. Hasegawa (Eds.), Management of Multimedia Networks and Services. XII, 384 pages. 2005.
- Vol. 3753: O.F. Olsen, L.M.J. Florack, A. Kuijper (Eds.), Deep Structure, Singularities, and Computer Vision. X, 259 pages. 2005.
- Vol. 3752: N. Paragios, O. Faugeras, T. Chan, C. Schnörr (Eds.), Variational, Geometric, and Level Set Methods in Computer Vision. XI, 369 pages. 2005.
- Vol. 3751: T. Magedanz, E.R.M. Madeira, P. Dini (Eds.), Operations and Management in IP-Based Networks. X, 213 pages. 2005.
- Vol. 3750: J.S. Duncan, G. Gerig (Eds.), Medical Image Computing and Computer-Assisted Intervention - MICCAI 2005, Part II. XL, 1018 pages. 2005.
- Vol. 3749: J.S. Duncan, G. Gerig (Eds.), Medical Image Computing and Computer-Assisted Intervention - MICCAI 2005, Part I. XXXIX, 942 pages. 2005.

¥585.28元

Table of Contents

Generic Relationships in Information Modeling <i>Mohamed Dahchour, Alain Pirotte, Esteban Zimányi</i>	1
EMMA – A Formal Basis for Querying Enhanced Multimedia Meta Objects <i>Sonja Zillner, Werner Winiwarter</i>	35
Comparing and Transforming Between Data Models Via an Intermediate Hypergraph Data Model <i>Michael Boyd, Peter McBrien</i>	69
iASA: Learning to Annotate the Semantic Web <i>Jie Tang, Juanzi Li, Hongjun Lu, Bangyong Liang, Xiaotong Huang, Kehong Wang</i>	110
A Survey of Schema-Based Matching Approaches <i>Pavel Shvaiko, Jérôme Euzenat</i>	146
An Overview and Classification of Adaptive Approaches to Information Extraction <i>Christian Siefkes, Peter Siniakov</i>	172
View Integration and Cooperation in Databases, Data Warehouses and Web Information Systems <i>Hui Ma, Klaus-Dieter Schewe, Bernhard Thalheim, Jane Zhao</i>	213
Semantic Integration of Tree-Structured Data Using Dimension Graphs <i>Theodore Dalamagas, Dimitri Theodoratos, Antonis Koufopoulos, I-Ting Liu</i>	250
KDD Support Services Based on Data Semantics <i>Claudia Diamantini, Domenico Potena, Maurizio Panti</i>	280
Integrating the Two Main Inference Modes of NKRL, Transformations and Hypotheses <i>Gian Piero Zarri</i>	304
Author Index	341

Generic Relationships in Information Modeling

Mohamed Dahchour¹, Alain Pirotte², and Esteban Zimányi³

¹ Institut National des Postes et Télécommunications,
Av. Allal Al Fassi, Rabat, Morocco
`dahchour@inpt.ac.ma`

² Université catholique de Louvain, IAG School of Management,
1 Place des Doyens, B-1348 Louvain-la-Neuve, Belgium
`pirotte@info.ucl.ac.be`

³ Université Libre de Bruxelles, Department of Computer and Network Engineering,
CP 165/15, 50 Av. F. Roosevelt, B-1050 Brussels, Belgium
`ezimanyi@ulb.ac.be`

Abstract. Generic relationships are abstraction patterns used for structuring information across application domains. They play a central role in information modeling. However, the state of the art of handling generic relationships leaves open a number of problems, like differences in the definition of some generic relationships in various data models and differences in the importance given to some generic relationships, considered as first-class constructs in some models and as special cases of other relationships in other models. To address those problems, we define a list of dimensions to characterize the semantics of generic relationships in a clear and systematic way. The list aims to offer a uniform and comprehensive analysis grid for generic relationships, drawn from a careful analysis of commonalities and differences among the generic relationships discussed in the literature. The usefulness of those dimensions is illustrated by reviewing significant generic relationships, namely, materialization, role, aggregation, grouping, and ownership. Based on those dimensions, a new metamodel for relationships is proposed.

1 Introduction

Information modeling is the activity of creating abstract representations of some aspects of physical and social systems and their environment. Information models are typically built in the early stages of system development, preceding design and implementation. But information models can also be useful even if no system is contemplated: they then serve to clarify ideas about structure and functions in a perception of the world.

Advances in information modeling involve narrowing the gap between concepts in the real world and their representation in information models by identifying powerful abstractions allowing to better represent application semantics (see, e.g., [1,29,31,34,38,46]).

Generic relationships are such powerful abstraction mechanisms. They are high-level templates for relating real-world entities. Well-known generic relationships include the following.

- *Classification* relates a class with a set of objects sharing the same properties. An object must be an instance of at least one class. It is also known as *is-of*. For example John is an instance of class *Person*.
- *Association* represents a structural connection among classes. Associations can be *binary* or *n-ary* ($n \geq 3$). An example of a binary association is *teaches(Professor,Course)*. An example of a ternary association is *prescription(Doctor,Medicine, Patient)*.
- *Generalization* relates *superclasses* to their specializations called *subclasses*. Subclasses inherit all properties (attributes, methods, roles, integrity constraints) from their superclasses. Subclasses may define new specific properties. For example, *Vehicle* is a generalization of *Car*.
- *Aggregation* associates an *aggregate* (or whole or composite) to its *components* (or parts). It is also known as *part-whole* or *part-of*. For example, *Car* is an aggregation of *Body*, *Engine*, and *Wheel*.

Generic relationships model patterns abstracting collections of related *specific* relationships. Specific relationships are instances of generic relationships in a particular application. For example, $\text{Vehicle} \leftarrow \text{Car}$ is a specific generalization with pattern $\text{SuperClass} \leftarrow \text{SubClass}$ (see Figure 1).

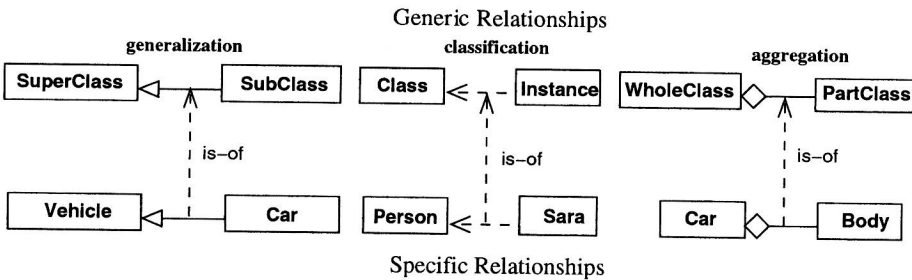


Fig. 1. Generic and specific relationships

Research on information modeling has studied other generic relationships like *materialization* [9], *ownership* [48], *role* [45,10], *grouping* [33], *viewpoint* [32], *generation* [14], *versioning* [3,21], *realization* [25], *transition* [15], and *refinement* [41]. These generic relationships naturally model phenomena typical of complex application domains whose semantics escapes direct representation with classical generic relationships (i.e., association, generalization, classification, and aggregation).

Generic relationships play a central role in information modeling. However, the state of the art of handling them leaves open a number of problems. The semantics of some generic relationships differs among models. Other generic relationships have often been badly understood, underestimated, or merely ignored in some models. In addition, some generic relationships, considered as first-class constructs in some models, are considered as special cases of other relationships in other models. For instance, in UML [41], the aggregation relationship

is considered a special kind of the ordinary association, whereas in most models (e.g., [46,36,19,30,23]) aggregation enjoys a status of its own and comes with more specific features than those defined in UML. Another example concerns the *grouping* relationship relating a collection (e.g., TennisClub) and its members (e.g., TennisPlayer). Grouping was defined in [33] as an independent generic relationship with specific characteristics, while it is just considered as a special case of aggregation, e.g., in [46,19].

Another problem concerns the adequacy of choosing some generic relationships rather than others when modeling an application domain. For example, it can be argued that the relationship between students and employees on the one hand and persons on the other hand is more adequately modeled as a role relationship than as a generalization. Generalization seems more adequate to represent the relationship between males and females on the one hand and persons on the other hand. The idea is that the role relationship captures the temporal and evolutionary aspects of real-world objects (e.g., persons may be students and later become employees), while the usual generalization relationship deals with their more static aspects (e.g., most persons are permanently males or females).

Such difficult questions of adequacy or validity of generic relationships for modeling real-world situations are not directly discussed in this paper, although they are illustrated through a number of examples. Instead, the paper precisely characterizes the structural semantics of generic relationships, to help conceptual database designers precisely evaluate the adequacy of choosing one model rather than another.

We argue that some problems with generic relationships mainly concern the absence of formalizable dimensions or criteria along which the relationships can be characterized in a systematic way. The paper defines such dimensions and illustrates their effectiveness by reviewing some generic relationships. Implementation issues are not presented in this paper. They are discussed in detail in [8].

Notations and Conventions. Table 1 gathers the main notations used in the paper. We use UML [41] notations to specify classes, instances, generalization, instantiation, and aggregation. We add notations to represent concepts that have no equivalent in UML. We prefer to draw associations as boxes with rounded corners rather than using the UML notation. As in UML, instances of relationships are called links.

The rest of the paper is organized as follows. Section 2 presents a preliminary classification of generic relationships. Section 3 presents an overview of our relationship model. Section 4 presents the characteristics of a basic binary relationship (denoted *BBR*). Section 5 defines a set of dimensions that characterize binary generic relationships. Section 6 reviews several generic relationships in the light of those dimensions. Section 7 gives some guidelines to identify and define new generic relationships. Section 8 presents a new metamodel for generic relationships based on their semantics as presented in Sections 4 and 5. Section 9 summarizes and concludes the paper.

Table 1. Notations and their meanings

Notation	Meaning
$I \dashrightarrow C$ or $I \in C$	I is an instance of class C
$C_1 \text{---}\boxed{R}\text{---}C_2$	R is a binary association between classes C_1 and C_2
$S \dashrightarrow G$	S is a subclass of superclass G
$W \diamond \text{---} P$	whole class W is composed of part class P
$A \text{---}\star C$	abstract class A materializes as concrete class C
$R \rightarrow \circ O$	R is a role class of object class O
$O \prec \dots P$	owner class O owns property class P
$M \rightarrow S$	M is a member class of set S
$\mathcal{B}\mathcal{B}\mathcal{R}$	the basic binary relationship
$C_1 \text{---}\overset{R}{\text{---}} C_2$	R is a binary relationship between classes C_1 and C_2
$\rho_C(R)$	the role played by class C in relationship R
$C_1(v_1, v_2) \text{---}\overset{R}{\text{---}} C_2$	cardinality of role $\rho_{C_1}(R)$ is (v_1, v_2)
$\pi_C(R)$	the set of instances of C participating in R with role $\rho_C(R)$
$R(C_1, C_2)$	R relates C_1 and C_2
$R(c_1, c_2)$	there is an instance of R (a link) relating c_1 and c_2
$R_1 \otimes R_2$	relationships R_1 and R_2 are exclusive
$\rho_C(R_1) \otimes \rho_C(R_2)$	roles $\rho_C(R_1)$ and $\rho_C(R_2)$ are exclusive
$R_1 \subseteq R_2$	relationship R_1 is inclusive in relationship R_2
$\rho_C(R_1) \subseteq \rho_C(R_2)$	role $\rho_C(R_1)$ is inclusive in role $\rho_C(R_2)$
$C_0 \text{---}\overset{R \mid d}{\text{---}} \{C_1, \dots, C_n\}$	partition of R in classes C_i according to discriminator d

2 Classification of Generic Relationships

Generic relationships can be classified along the following three orthogonal dimensions, as depicted in Figure 2: (1) degree, (2) structurality and dynamicity, and (3) dependency on application domains.

Degree. It is the number of participating classes in a relationship. A relationship of degree two is said to be *binary*, and one of degree n ($n \geq 3$) is *n-ary*. Examples of binary generic relationships include:

- *classification* (of pattern $\text{Class} \leftarrow \text{Instance}$) relates an instance (e.g., Sarah) to its class (e.g., person);
- *generalization* (of pattern $\text{SuperClass} \leftarrow \text{SubClass}$) relates a superclass (e.g., persons) to its subclasses (e.g., males and females).
- *materialization* (of pattern $\text{Abstract} \text{---}\star \text{Concrete}$) [39,9] relates a class of categories (e.g., models of cars) with a class of more concrete objects (e.g., individual cars);
- *ownership* (of pattern $\text{Property} \cdot \prec \cdot \text{Owner}$) [48] relates an owner class (e.g., persons) and a property (e.g., cars) possessed by their objects;
- *aggregation* (of pattern $\text{WholeClass} \diamond \text{---} \text{PartClass}$) [30,46] relates composites (e.g., cars) to their components (e.g., body and engine);