LNCS 3643

Roberto Moreno Díaz
Franz Pichler
Alexis Quesada Arencibia (Eds.)

Computer Aided Systems Theory – EUROCAST 2005

10th International Conference on Computer Aided Systems Theory
Las Palmas de Gran Canaria, Spain, February 2005
Revised Selected Papers

Springer

Roberto Moreno Díaz   Franz Pichler
Alexis Quesada Arencibia (Eds.)

Computer Aided Systems Theory – EUROCAST 2005

10th International Conference on Computer Aided Systems Theory
Las Palmas de Gran Canaria, Spain, February 7 – 11, 2005
Revised Selected Papers

Springer

Volume Editors

Roberto Moreno Díaz
Universidad de Las Palmas de Gran Canaria
Instituto Universitario de Ciencias y Tecnologícas Cibernéticas
Campus de Tafira, 35017, Las Palmas de Gran Canaria, Las Palmas, Spain
E-mail: rmoreno@ciber.ulpgc.es

Franz Pichler
Johannes Kepler University Linz
Institute of Systems Science
Austria
E-mail: pichler@cast.uni-linz.ac.at

Alexis Quesada Arencibia
Universidad de Las Palmas de Gran Canaria
Instituto Universitario de Ciencias y Tecnologícas Cibernéticas
Campus de Tafira, 35017, Las Palmas de Gran Canaria, Las Palmas, Spain
E-mail: aquesada@dis.ulpgc.es

Library of Congress Control Number: 2005932551

CR Subject Classification (1998): J.6, I.6, I.2, J.7, J.3, C.1.m, C.3, F.4, F.3

ISSN 0302-9743
ISBN-10 3-540-29002-8 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-29002-5 Springer Berlin Heidelberg New York

Springer is a part of Springer Science+Business Media

springeronline.com

Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 11556985 06/3142 5 4 3 2 1 0

Lecture Notes in Computer Science 3643

Lecture Notes in Computer Science

For information about Vols. 1–3620

please contact your bookseller or Springer

Vol. 3728: V. Paliouras, J. Vounckx, D. Verkest (Eds.), Integrated Circuit and System Design. XV, 753 pages. 2005.

Vol. 3726: L.T. Yang, O.F. Rana, B. Di Martino, J. Dongarra (Eds.), High Performance Computing and Communcations. XXVI, 1116 pages. 2005.

Vol. 3718: V.G. Ganzha, E.W. Mayr, E.V. Vorozhtsov (Eds.), Computer Algebra in Scientific Computing. XII, 502 pages. 2005.

Vol. 3715: E. Dawson, S. Vaudenay (Eds.), Progress in Cryptology – Mycrypt 2005. XI, 329 pages. 2005.

Vol. 3714: H. Obbink, K. Pohl (Eds.), Software Product Lines. XIII, 235 pages. 2005.

Vol. 3713: L. Briand, C. Williams (Eds.), Model Driven Engineering Languages and Systems. XV, 722 pages. 2005.

Vol. 3712: R. Reussner, J. Mayer, J.A. Stafford, S. Overhage, S. Becker, P.J. Schroeder (Eds.), Quality of Software Architectures and Software Quality. XIII, 289 pages. 2005.

Vol. 3711: F. Kishino, Y. Kitamura, H. Kato, N. Nagata (Eds.), Entertainment Computing - ICEC 2005. XXIV, 540 pages. 2005.

Vol. 3710: M. Barni, I. Cox, T. Kalker, H.J. Kim (Eds.), Digital Watermarking. XII, 485 pages. 2005.

Vol. 3708: J. Blanc-Talon, W. Philips, D. Popescu, P. Scheunders (Eds.), Advanced Concepts for Intelligent Vision Systems. XXII, 725 pages. 2005.

Vol. 3706: H. Fuks, S. Lukosch, A.C. Salgado (Eds.), Groupware: Design, Implementation, and Use. XII, 378 pages. 2005.

Vol. 3703: F. Fages, S. Soliman (Eds.), Principles and Practice of Semantic Web Reasoning. VIII, 163 pages. 2005.

Vol. 3702: B. Beckert (Ed.), Automated Reasoning with Analytic Tableaux and Related Methods. XIII, 343 pages. 2005. (Subseries LNAI).

Vol. 3699: C.S. Calude, M.J. Dinneen, G. Paun, M.J. Pérez-Jiménez, G. Rozenberg (Eds.), Unconventional Computation. XI, 267 pages. 2005.

Vol. 3698: U. Furbach (Ed.), KI 2005: Advances in Artificial Intelligence. XIII, 409 pages. 2005. (Subseries LNAI).

Vol. 3697: W. Duch, J. Kacprzyk, E. Oja, S. Zadrożny (Eds.), Artificial Neural Networks: Formal Models and Their Applications – ICANN 2005, Part II. XXXII, 1045 pages. 2005.

Vol. 3696: W. Duch, J. Kacprzyk, E. Oja, S. Zadrożny (Eds.), Artificial Neural Networks: Biological Inspirations – ICANN 2005, Part I. XXXI, 703 pages. 2005.

Vol. 3695: M.R. Berthold, R. Glen, K. Diederichs, O. Kohlbacher, I. Fischer (Eds.), Computational Life Sciences. XI, 277 pages. 2005. (Subseries LNBI).

Vol. 3694: M. Malek, E. Nett, N. Suri (Eds.), Service Availability. VIII, 213 pages. 2005.

Vol. 3693: A.G. Cohn, D.M. Mark (Eds.), Spatial Information Theory. XII, 493 pages. 2005.

Vol. 3691: A. Gagalowicz, W. Philips (Eds.), Computer Analysis of Images and Patterns. XIX, 865 pages. 2005.

Vol. 3690: M. Pěchouček, P. Petta, L.Z. Varga (Eds.), Multi-Agent Systems and Applications IV. XVII, 667 pages. 2005. (Subseries LNAI).

Vol. 3687: S. Singh, M. Singh, C. Apte, P. Perner (Eds.), Pattern Recognition and Image Analysis, Part II. XXV, 809 pages. 2005.

Vol. 3686: S. Singh, M. Singh, C. Apte, P. Perner (Eds.), Pattern Recognition and Data Mining, Part I. XXVI, 689 pages. 2005.

Vol. 3685: V. Gorodetsky, I. Kotenko, V. Skormin (Eds.), Computer Network Security. XIV, 480 pages. 2005.

Vol. 3684: R. Khosla, R.J. Howlett, L.C. Jain (Eds.), Knowledge-Based Intelligent Information and Engineering Systems, Part IV. LXXIX, 933 pages. 2005. (Subseries LNAI).

Vol. 3683: R. Khosla, R.J. Howlett, L.C. Jain (Eds.), Knowledge-Based Intelligent Information and Engineering Systems, Part III. LXXX, 1397 pages. 2005. (Subseries LNAI).

Vol. 3682: R. Khosla, R.J. Howlett, L.C. Jain (Eds.), Knowledge-Based Intelligent Information and Engineering Systems, Part II. LXXIX, 1371 pages. 2005. (Subseries LNAI).

Vol. 3681: R. Khosla, R.J. Howlett, L.C. Jain (Eds.), Knowledge-Based Intelligent Information and Engineering Systems, Part I. LXXX, 1319 pages. 2005. (Subseries LNAI).

Vol. 3679: S.d.C. di Vimercati, P. Syverson, D. Gollmann (Eds.), Computer Security – ESORICS 2005. XI, 509 pages. 2005.

Vol. 3678: A. McLysaght, D.H. Huson (Eds.), Comparative Genomics. VIII, 167 pages. 2005. (Subseries LNBI).

Vol. 3677: J. Dittmann, S. Katzenbeisser, A. Uhl (Eds.), Communications and Multimedia Security. XIII, 360 pages. 2005.

Vol. 3675: Y. Luo (Ed.), Cooperative Design, Visualization, and Engineering. XI, 264 pages. 2005.

Vol. 3674: W. Jonker, M. Petković (Eds.), Secure Data Management. X, 241 pages. 2005.

Vol. 3672: C. Hankin, I. Siveroni (Eds.), Static Analysis. X, 369 pages. 2005.

Vol. 3671: S. Bressan, S. Ceri, E. Hunt, Z.G. Ives, Z. Bellahsène, M. Rys, R. Unland (Eds.), Database and XML Technologies. X, 239 pages. 2005.

Vol. 3670: M. Bravetti, L. Kloul, G. Zavattaro (Eds.), Formal Techniques for Computer Systems and Business Processes. XIII, 349 pages. 2005.

Vol. 3666: B.D. Martino, D. Kranzlmüller, J. Dongarra (Eds.), Recent Advances in Parallel Virtual Machine and Message Passing Interface. XVII, 546 pages. 2005.

Vol. 3665: K. S. Candan, A. Celentano (Eds.), Advances in Multimedia Information Systems. X, 221 pages. 2005.

Vol. 3664: C. Türker, M. Agosti, H.-J. Schek (Eds.), Peer-to-Peer, Grid, and Service-Orientation in Digital Library Architectures. X, 261 pages. 2005.

Vol. 3663: W.G. Kropatsch, R. Sablatnig, A. Hanbury (Eds.), Pattern Recognition. XIV, 512 pages. 2005.

Vol. 3662: C. Baral, G. Greco, N. Leone, G. Terracina (Eds.), Logic Programming and Nonmonotonic Reasoning. XIII, 454 pages. 2005. (Subseries LNAI).

Vol. 3661: T. Panayiotopoulos, J. Gratch, R. Aylett, D. Ballin, P. Olivier, T. Rist (Eds.), Intelligent Virtual Agents. XIII, 506 pages. 2005. (Subseries LNAI).

Vol. 3660: M. Beigl, S. Intille, J. Rekimoto, H. Tokuda (Eds.), UbiComp 2005: Ubiquitous Computing. XVII, 394 pages. 2005.

Vol. 3659: J.R. Rao, B. Sunar (Eds.), Cryptographic Hardware and Embedded Systems – CHES 2005. XIV, 458 pages. 2005.

Vol. 3658: V. Matoušek, P. Mautner, T. Pavelka (Eds.), Text, Speech and Dialogue. XV, 460 pages. 2005. (Subseries LNAI).

Vol. 3657: F.S. de Boer, M.M. Bonsangue, S. Graf, W.-P. de Roever (Eds.), Formal Methods for Components and Objects. VIII, 325 pages. 2005.

Vol. 3656: M. Kamel, A. Campilho (Eds.), Image Analysis and Recognition. XXIV, 1279 pages. 2005.

Vol. 3655: A. Aldini, R. Gorrieri, F. Martinelli (Eds.), Foundations of Security Analysis and Design III. VII, 273 pages. 2005.

Vol. 3654: S. Jajodia, D. Wijesekera (Eds.), Data and Applications Security XIX. X, 353 pages. 2005.

Vol. 3653: M. Abadi, L. de Alfaro (Eds.), CONCUR 2005 – Concurrency Theory. XIV, 578 pages. 2005.

Vol. 3652: A. Rauber, S. Christodoulakis, A M. Tjoa (Eds.), Research and Advanced Technology for Digital Libraries. XVIII, 545 pages. 2005.

Vol. 3650: J. Zhou, J. Lopez, R.H. Deng, F. Bao (Eds.), Information Security. XII, 516 pages. 2005.

Vol. 3649: W.M. P. van der Aalst, B. Benatallah, F. Casati, F. Curbera (Eds.), Business Process Management. XII, 472 pages. 2005.

Vol. 3648: J.C. Cunha, P.D. Medeiros (Eds.), Euro-Par 2005 Parallel Processing. XXXVI, 1299 pages. 2005.

Vol. 3646: A. F. Famili, J.N. Kok, J.M. Peña, A. Siebes, A. Feelders (Eds.), Advances in Intelligent Data Analysis VI. XIV, 522 pages. 2005.

Vol. 3645: D.-S. Huang, X.-P. Zhang, G.-B. Huang (Eds.), Advances in Intelligent Computing, Part II. XIII, 1010 pages. 2005.

Vol. 3644: D.-S. Huang, X.-P. Zhang, G.-B. Huang (Eds.), Advances in Intelligent Computing, Part I. XXVII, 1101 pages. 2005.

Vol. 3643: R. Moreno Díaz, F. Pichler, A. Quesada Arencibia (Eds.), Computer Aided Systems Theory – EUROCAST 2005. XIV, 629 pages. 2005.

Vol. 3642: D. Ślezak, J. Yao, J.F. Peters, W. Ziarko, X. Hu (Eds.), Rough Sets, Fuzzy Sets, Data Mining, and Granular Computing, Part II. XXIII, 738 pages. 2005. (Subseries LNAI).

Vol. 3641: D. Ślezak, G. Wang, M. Szczuka, I. Düntsch, Y. Yao (Eds.), Rough Sets, Fuzzy Sets, Data Mining, and Granular Computing, Part I. XXIV, 742 pages. 2005. (Subseries LNAI).

Vol. 3639: P. Godefroid (Ed.), Model Checking Software. XI, 289 pages. 2005.

Vol. 3638: A. Butz, B. Fisher, A. Krüger, P. Olivier (Eds.), Smart Graphics. XI, 269 pages. 2005.

Vol. 3637: J. M. Moreno, J. Madrenas, J. Cosp (Eds.), Evolvable Systems: From Biology to Hardware. XI, 227 pages. 2005.

Vol. 3636: M.J. Blesa, C. Blum, A. Roli, M. Sampels (Eds.), Hybrid Metaheuristics. XII, 155 pages. 2005.

Vol. 3634: L. Ong (Ed.), Computer Science Logic. XI, 567 pages. 2005.

Vol. 3633: C. Bauzer Medeiros, M. Egenhofer, E. Bertino (Eds.), Advances in Spatial and Temporal Databases. XIII, 433 pages. 2005.

Vol. 3632: R. Nieuwenhuis (Ed.), Automated Deduction – CADE-20. XIII, 459 pages. 2005. (Subseries LNAI).

Vol. 3631: J. Eder, H.-M. Haav, A. Kalja, J. Penjam (Eds.), Advances in Databases and Information Systems. XIII, 393 pages. 2005.

Vol. 3630: M.S. Capcarrere, A.A. Freitas, P.J. Bentley, C.G. Johnson, J. Timmis (Eds.), Advances in Artificial Life. XIX, 949 pages. 2005. (Subseries LNAI).

Vol. 3629: J.L. Fiadeiro, N. Harman, M. Roggenbach, J. Rutten (Eds.), Algebra and Coalgebra in Computer Science. XI, 457 pages. 2005.

Vol. 3628: T. Gschwind, U. Aßmann, O. Nierstrasz (Eds.), Software Composition. X, 199 pages. 2005.

Vol. 3627: C. Jacob, M.L. Pilat, P.J. Bentley, J. Timmis (Eds.), Artificial Immune Systems. XII, 500 pages. 2005.

Vol. 3626: B. Ganter, G. Stumme, R. Wille (Eds.), Formal Concept Analysis. X, 349 pages. 2005. (Subseries LNAI).

Vol. 3625: S. Kramer, B. Pfahringer (Eds.), Inductive Logic Programming. XIII, 427 pages. 2005. (Subseries LNAI).

Vol. 3624: C. Chekuri, K. Jansen, J.D. P. Rolim, L. Trevisan (Eds.), Approximation, Randomization and Combinatorial Optimization. XI, 495 pages. 2005.

Vol. 3623: M. Liśkiewicz, R. Reischuk (Eds.), Fundamentals of Computation Theory. XV, 576 pages. 2005.

Vol. 3622: V. Vene, T. Uustalu (Eds.), Advanced Functional Programming. IX, 359 pages. 2005.

Vol. 3621: V. Shoup (Ed.), Advances in Cryptology – CRYPTO 2005. XI, 568 pages. 2005.

Preface

The concept of CAST, computer aided systems Theory, was introduced by F. Pichler of Linz in the late 1980s to include those computer theoretical and practical developments used as tools to solve problems in system science. It was considered as the third component (the other two being CAD and CAM) that would provide for a complete picture of the path from computer and systems sciences to practical developments in science and engineering.

The University of Linz organized the first CAST workshop in April 1988, which demonstrated the acceptance of the concepts by the scientific and technical community. Next, the University of Las Palmas de Gran Canaria joined the University of Linz to organize the first international meeting on CAST (Las Palmas February 1989), under the name EUROCAST 1989, a very successful gathering of systems theorists, computer scientists and engineers from most European countries, North America and Japan.

It was agreed that EUROCAST international conferences would be organized every two years. Thus, the following EUROCAST meetings took place in Krems (1991), Las Palmas (1993), Innsbruck (1995), Las Palmas (1997), Vienna (1999), Las Palmas (2001) and Las Palmas (2003) in addition to an extra-European CAST conference in Ottawa in 1994. Selected papers from those meetings were published as Springer Lecture Notes in Computer Science vols. 410, 585, 763, 1030, 1333, 1728, 2178 and 2809 and in several special issues of Cybernetics and Systems: an International Journal. EUROCAST and CAST meetings are definitely consolidated, as has been demonstrated by the number and quality of the contributions over the years.

EUROCAST 2005 (Las Palmas, February 2005) continued with a new approach to the conferences which was adopted in 2001. Besides the classical core on generic CAST, chaired by Pichler and Moreno-Diaz, there were workshops on Computation and Simulation in Modelling Biological Systems, chaired by Ricciardi (Naples); Cryptography, chaired by Müller (Klagenfurt); Intelligent Information Processing, chaired by Freire (A Coruña); Robotics and Robot Soccer, chaired by Kopacek (Vienna) and Pfalgraf (Salzburg); Spectral Methods, chaired by Astola (Tampere); and Computer Vision and Intelligent Vehicular Systems, chaired by Maravall and García Rosa (Madrid).

This volume contains the full papers selected after the oral presentations of the different sessions. The editors would like to thank all contributors for their quickness in providing their material in hard and electronic forms. Special thanks are due to the staff of Springer Heidelberg for their valuable support.

July 2005 Roberto Moreno-Díaz, Franz Pichler and Alexis Quesada-Arencibia

Table of Contents

Formal Approaches in Modelling

Intelligent Information Systems

Information Applications Components

Cryptography and Spectral Analysis

Computer Vision

Biocomputing

Intelligent Vehicular Sytems

Robotic Soccer, Robotics and Control

On the Physical Formal and Semantic Frontiers Between Human Knowing and Machine Knowing

José Mira Mira

Dpto. de Inteligencia Artificial,
ETSI. Informática. UNED, Madrid, Spain
jmira@dia.uned.es

Abstract. The purpose of this paper is to reflect on the nature of human knowledge and that of the knowledge that finally can dwell in an electronic computer. Three frontiers can be distinguished between these two constitutively different types of knowing: (1) The nature of current physical machines (silicon semiconductor crystal) and its organizational restrictions in relation with the biological tissue, which is autonomous, dynamic, tolerant to failures, self-organizative, and adaptive. (2) The semantics of the available algorithms and programming languages in relation with the evolutionary and reactive (behavior-based) biological programming strategies. (3) The nature of current formal tools in relation with natural language.

1 Problem Statement

A great part of the AI community attempts to interpret and use concepts of the computational paradigm when applied to natural systems as equivalent to the corresponding concepts when applied to artificial systems. These scientists assume that natural language can be reduced to formal language, that biological programming strategies can be reduced to conventional programming languages and that the nervous tissue and a body of meat can be reduced to a CPU of Silicon crystal and an electro-mechanical robot. Unfortunately, fifty years after the christening of AI at the 1956 summer conference at Dartmouth Colleague, this is not the case. There are relevant, constitutive, differences between Computation in Natural Systems (the human way of knowing) and Computation in Artificial Systems (the machine way of knowing). To contribute to the establishment of a clear distinction between these two different ways of knowing we introduce in section two the methodological building of knowledge [11,9,10], which will enable us to distinguish between three levels and two domains of description of the knowledge involved in a calculus. In sections three, four and five, making reverse engineering, we consider the knowledge that each one of these levels can accommodate, from the physical level to the symbol level and, finally, to the knowledge level. Then we conclude, mentioning the topics in which, in our opinion, we should concentrate our efforts to move the frontiers between human intelligence and machine intelligence.

R. Moreno Díaz et al. (Eds.): EUROCAST 2005, LNCS 3643, pp. 1–8, 2005.

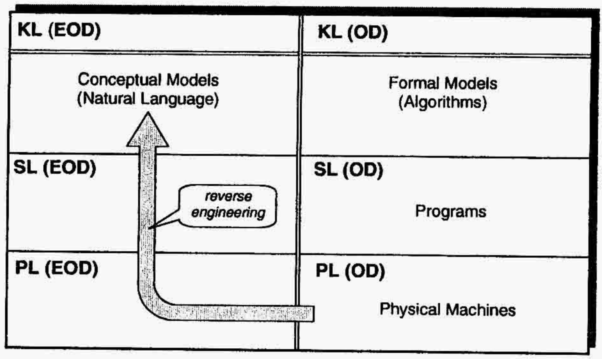

Fig. 1. Reverse engineering in the building of knowledge

2 Direct and Reverse Engineering Inside the Building of Knowledge

The three levels (storey) of the building for knowledge are the physical level where lives the machine hardware, the symbol level where the programs live and the third level, introduced by Allen Newell [12] and David Marr [4], located over the symbol level and named by Newell the knowledge level and by Marr the level of the theory of calculus. Additionally the external observer of a calculus (either in natural or in artificial systems) always can distinguish between two domains of description in each level [6,15,8]: the level's own domain, OD, and the domain of the external observer (EOD), as shown in figure 1.

In direct engineering we start with a conceptual model at the KL and in the EOD of the method used by humans to solve a problem. The architecture of this model depends on the AI paradigm used in our approach (symbolic, connectionist, situated or hybrid). Then we use a table of correspondences to move from this conceptual model to the abstract entities and relations of a formal model situated in the OD of the KL (the 3rd right apartment). Next we program the formal model and a compiler ends the work by producing the final machine language version of the program.

In this formalization process we have left out (in the third left apartments) a great part of the human knowledge used in the conceptual model. This non-computable knowledge establishes the first semantic and formal frontier between human knowing and machine knowing. Only the formal model underlying natural language words enters the computer. The rest of the knowledge always remains in the natural language of the external observer, in the EOD. Obviously the external observer injects this non-computable knowledge when he interprets the results of the calculus (left hand bottom-up pathway in figure 1).

If we now attempt to recover the conceptual model from which this calculus has emerged we have to make reverse engineering, starting on the first right apartment where the program is running in a physical machine, going through the symbol level and ending at the EOD of the KL. In this reverse pathway