

James C. Lester
Rosa Maria Vicari
Fábio Paraguaçu (Eds.)

LNCS 3220

Intelligent Tutoring Systems

7th International Conference, ITS 2004
Maceió, Alagoas, Brazil, August/September 2004
Proceedings

 Springer

TP18-53

I61.6

James C. Lester Rosa Maria Vicari
Fábio Paraguaçu (Eds.)

2004

Intelligent Tutoring Systems

7th International Conference, ITS 2004
Maceió, Alagoas, Brazil, August 30 – September 3, 2004
Proceedings



E200404380



Springer

Volume Editors

James C. Lester

North Carolina State University, Department of Computer Science

Box 7535, Raleigh, NC 27695-7535, USA

E-mail: lester@csc.ncsu.edu

Rosa Maria Vicari

Federal University of Rio Grande do Sul, Instituto de Informática

Av. Bento Goncalves, 1500, Campus do Vale, Bloco IV, Bairro Agronomia

9500, Porto Alegre, RS, Brazil

E-mail: rosa@inf.ufrgs.br

Fábio Paraguaçu

Federal University of Alagoas, Department of Information Technologies

Campus A.C. Simões, Tabuleiro dos Martins, Maceió, AL 57072-970, Brazil

E-mail: paragua@tci.ufal.br

Library of Congress Control Number: 2004110895

CR Subject Classification (1998): K.3, I.2.6, H.5, J.1

ISSN 0302-9743

ISBN 3-540-22948-5 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

springeronline.com

© Springer-Verlag Berlin Heidelberg 2004

Printed in Germany

Typesetting: Camera-ready by author, data conversion by PTP-Berlin, Protago-TeX-Production GmbH

Printed on acid-free paper

SPIN: 11316176

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

Lecture Notes in Computer Science

For information about Vols. 1–3075

please contact your bookseller or Springer

- Vol. 3220: J.C. Lester, R.M. Vicari, F. Paraguaçu (Eds.), *Intelligent Tutoring Systems*. XXI, 920 pages. 2004.
- Vol. 3207: L.T. Jang, M. Guo, G.R. Gao, N.K. Jha, *Embedded and Ubiquitous Computing*. XX, 1116 pages. 2004.
- Vol. 3205: N. Davies, E. Mynatt, I. Siiio (Eds.), *UbiComp 2004: Ubiquitous Computing*. XVI, 452 pages. 2004.
- Vol. 3198: G.-J. de Vreede, L.A. Guerrero, G. Marín Raventós (Eds.), *Groupware: Design, Implementation and Use*. XI, 378 pages. 2004.
- Vol. 3194: R. Camacho, R. King, A. Srinivasan (Eds.), *Inductive Logic Programming*. XI, 361 pages. 2004. (Subseries LNAI).
- Vol. 3186: Z. Bellahsene, T. Milo, M. Rys, D. Suciu, R. Unland (Eds.), *Database and XML Technologies*. X, 235 pages. 2004.
- Vol. 3184: S. Katsikas, J. Lopez, G. Pernul (Eds.), *Trust and Privacy in Digital Business*. XI, 299 pages. 2004.
- Vol. 3183: R. Traumnüller (Ed.), *Electronic Government*. XIX, 583 pages. 2004.
- Vol. 3182: K. Bauknecht, M. Bichler, B. Pröll (Eds.), *E-Commerce and Web Technologies*. XI, 370 pages. 2004.
- Vol. 3178: W. Jonker, M. Petkovic (Eds.), *Secure Data Management*. VIII, 219 pages. 2004.
- Vol. 3177: Z.R. Yang, H. Yin, R. Everson (Eds.), *Intelligent Data Engineering and Automated Learning – IDEAL 2004*. XVIII, 852 pages. 2004.
- Vol. 3174: F. Yin, J. Wang, C. Guo (Eds.), *Advances in Neural Networks - ISNN 2004*. XXXV, 1021 pages. 2004.
- Vol. 3172: M. Dorigo, M. Birattari, C. Blum, L. M. Gambardella, F. Mondada, T. Stützle (Eds.), *Ant Colony, Optimization and Swarm Intelligence*. XII, 434 pages. 2004.
- Vol. 3166: M. Rauterberg (Ed.), *Entertainment Computing – ICEC 2004*. XXIII, 617 pages. 2004.
- Vol. 3158: I. Nikolaidis, M. Barbeau, E. Kranakis (Eds.), *Ad-Hoc, Mobile, and Wireless Networks*. IX, 344 pages. 2004.
- Vol. 3157: C. Zhang, H. W. Guesgen, W.K. Yeap (Eds.), *PRICAI 2004: Trends in Artificial Intelligence*. XX, 1023 pages. 2004. (Subseries LNAI).
- Vol. 3156: M. Joye, J.-J. Quisquater (Eds.), *Cryptographic Hardware and Embedded Systems - CHES 2004*. XIII, 455 pages. 2004.
- Vol. 3155: P. Funk, P.A. González Calero (Eds.), *Advances in Case-Based Reasoning*. XIII, 822 pages. 2004. (Subseries LNAI).
- Vol. 3154: R.L. Nord (Ed.), *Software Product Lines*. XIV, 334 pages. 2004.
- Vol. 3153: J. Fiala, V. Koubek, J. Kratochvíl (Eds.), *Mathematical Foundations of Computer Science 2004*. XIV, 902 pages. 2004.
- Vol. 3152: M. Franklin (Ed.), *Advances in Cryptology – CRYPTO 2004*. XI, 579 pages. 2004.
- Vol. 3150: G.-Z. Yang, T. Jiang (Eds.), *Medical Imaging and Augmented Reality*. XII, 378 pages. 2004.
- Vol. 3149: M. Danelutto, M. Vanneschi, D. Laforenza (Eds.), *Euro-Par 2004 Parallel Processing*. XXXIV, 1081 pages. 2004.
- Vol. 3148: R. Giacobazzi (Ed.), *Static Analysis*. XI, 393 pages. 2004.
- Vol. 3146: P. Érdi, A. Esposito, M. Marinaro, S. Scarpetta (Eds.), *Computational Neuroscience: Cortical Dynamics*. XI, 161 pages. 2004.
- Vol. 3144: M. Papatriantafyllou, P. Huneil (Eds.), *Principles of Distributed Systems*. XI, 246 pages. 2004.
- Vol. 3143: W. Liu, Y. Shi, Q. Li (Eds.), *Advances in Web-Based Learning – ICWL 2004*. XIV, 459 pages. 2004.
- Vol. 3142: J. Diaz, J. Karhumäki, A. Lepistö, D. Sannella (Eds.), *Automata, Languages and Programming*. XIX, 1253 pages. 2004.
- Vol. 3140: N. Koch, P. Fraternali, M. Wirsing (Eds.), *Web Engineering*. XXI, 623 pages. 2004.
- Vol. 3139: F. Iida, R. Pfeifer, L. Steels, Y. Kuniyoshi (Eds.), *Embodied Artificial Intelligence*. IX, 331 pages. 2004. (Subseries LNAI).
- Vol. 3138: A. Fred, T. Caelli, R.P.W. Duin, A. Campilho, D.d. Ridder (Eds.), *Structural, Syntactic, and Statistical Pattern Recognition*. XXII, 1168 pages. 2004.
- Vol. 3137: P. De Bra, W. Nejdl (Eds.), *Adaptive Hypermedia and Adaptive Web-Based Systems*. XIV, 442 pages. 2004.
- Vol. 3136: F. Mezziane, E. Métails (Eds.), *Natural Language Processing and Information Systems*. XII, 436 pages. 2004.
- Vol. 3134: C. Zannier, H. Erdogmus, L. Lindstrom (Eds.), *Extreme Programming and Agile Methods - XP/Agile Universe 2004*. XIV, 233 pages. 2004.
- Vol. 3133: A.D. Pimentel, S. Vassiliadis (Eds.), *Computer Systems: Architectures, Modeling, and Simulation*. XIII, 562 pages. 2004.
- Vol. 3132: B. Dörmögen, V. Lifschitz (Eds.), *Logic Programming*. XII, 480 pages. 2004.
- Vol. 3131: V. Torra, Y. Narukawa (Eds.), *Modeling Decisions for Artificial Intelligence*. XI, 327 pages. 2004. (Subseries LNAI).

- Vol. 3130: A. Syropoulos, K. Berry, Y. Haralambous, B. Hughes, S. Peter, J. Plaice (Eds.), *TeX, XML, and Digital Typography*. VIII, 265 pages. 2004.
- Vol. 3129: Q. Li, G. Wang, L. Feng (Eds.), *Advances in Web-Age Information Management*. XVII, 753 pages. 2004.
- Vol. 3128: D. Asonov (Ed.), *Querying Databases Privately*. IX, 115 pages. 2004.
- Vol. 3127: K.E. Wolff, H.D. Pfeiffer, H.S. Delugach (Eds.), *Conceptual Structures at Work*. XI, 403 pages. 2004. (Subseries LNAI).
- Vol. 3126: P. Dini, P. Lorenz, J.N.d. Souza (Eds.), *Service Assurance with Partial and Intermittent Resources*. XI, 312 pages. 2004.
- Vol. 3125: D. Kozen (Ed.), *Mathematics of Program Construction*. X, 401 pages. 2004.
- Vol. 3124: J.N. de Souza, P. Dini, P. Lorenz (Eds.), *Telecommunications and Networking - ICT 2004*. XXVI, 1390 pages. 2004.
- Vol. 3123: A. Belz, R. Evans, P. Piwek (Eds.), *Natural Language Generation*. X, 219 pages. 2004. (Subseries LNAI).
- Vol. 3122: K. Jansen, S. Khanna, J.D.P. Rolim, D. Ron (Eds.), *Approximation, Randomization, and Combinatorial Optimization*. IX, 428 pages. 2004.
- Vol. 3121: S. Nikolettseas, J.D.P. Rolim (Eds.), *Algorithmic Aspects of Wireless Sensor Networks*. X, 201 pages. 2004.
- Vol. 3120: J. Shawe-Taylor, Y. Singer (Eds.), *Learning Theory*. X, 648 pages. 2004. (Subseries LNAI).
- Vol. 3118: K. Miesenberger, J. Klaus, W. Zagler, D. Burger (Eds.), *Computer Helping People with Special Needs*. XXIII, 1191 pages. 2004.
- Vol. 3116: C. Rattray, S. Maharaj, C. Shankland (Eds.), *Algebraic Methodology and Software Technology*. XI, 569 pages. 2004.
- Vol. 3114: R. Alur, D.A. Peled (Eds.), *Computer Aided Verification*. XII, 536 pages. 2004.
- Vol. 3113: J. Karhumäki, H. Maurer, G. Paun, G. Rozenberg (Eds.), *Theory Is Forever*. X, 283 pages. 2004.
- Vol. 3112: H. Williams, L. MacKinnon (Eds.), *Key Technologies for Data Management*. XII, 265 pages. 2004.
- Vol. 3111: T. Hagerup, J. Katajainen (Eds.), *Algorithm Theory - SWAT 2004*. XI, 506 pages. 2004.
- Vol. 3110: A. Juels (Ed.), *Financial Cryptography*. XI, 281 pages. 2004.
- Vol. 3109: S.C. Sahinalp, S. Muthukrishnan, U. Dogrusoz (Eds.), *Combinatorial Pattern Matching*. XII, 486 pages. 2004.
- Vol. 3108: H. Wang, J. Pieprzyk, V. Varadarajan (Eds.), *Information Security and Privacy*. XII, 494 pages. 2004.
- Vol. 3107: J. Bosch, C. Krueger (Eds.), *Software Reuse: Methods, Techniques and Tools*. XI, 339 pages. 2004.
- Vol. 3106: K.-Y. Chwa, J.I. Munro (Eds.), *Computing and Combinatorics*. XIII, 474 pages. 2004.
- Vol. 3105: S. Göbel, U. Spierling, A. Hoffmann, I. Iurgel, O. Schneider, J. Dechau, A. Feix (Eds.), *Technologies for Interactive Digital Storytelling and Entertainment*. XVI, 304 pages. 2004.
- Vol. 3104: R. Kralovic, O. Sykora (Eds.), *Structural Information and Communication Complexity*. X, 303 pages. 2004.
- Vol. 3103: K. Deb, e. al. (Eds.), *Genetic and Evolutionary Computation - GECCO 2004*. XLIX, 1439 pages. 2004.
- Vol. 3102: K. Deb, e. al. (Eds.), *Genetic and Evolutionary Computation - GECCO 2004*. L, 1445 pages. 2004.
- Vol. 3101: M. Masoodian, S. Jones, B. Rogers (Eds.), *Computer Human Interaction*. XIV, 694 pages. 2004.
- Vol. 3100: J.F. Peters, A. Skowron, J.W. Grzymala-Busse, B. Kostek, R.W. Świniarski, M.S. Szczuka (Eds.), *Transactions on Rough Sets I*. X, 405 pages. 2004.
- Vol. 3099: J. Cortadella, W. Reisig (Eds.), *Applications and Theory of Petri Nets 2004*. XI, 505 pages. 2004.
- Vol. 3098: J. Desel, W. Reisig, G. Rozenberg (Eds.), *Lectures on Concurrency and Petri Nets*. VIII, 849 pages. 2004.
- Vol. 3097: D. Basin, M. Rusinowitch (Eds.), *Automated Reasoning*. XII, 493 pages. 2004. (Subseries LNAI).
- Vol. 3096: G. Melnik, H. Holz (Eds.), *Advances in Learning Software Organizations*. X, 173 pages. 2004.
- Vol. 3095: C. Bussler, D. Fensel, M.E. Orłowska, J. Yang (Eds.), *Web Services, E-Business, and the Semantic Web*. X, 147 pages. 2004.
- Vol. 3094: A. Nürnberger, M. Detyniecki (Eds.), *Adaptive Multimedia Retrieval*. VIII, 229 pages. 2004.
- Vol. 3093: S. Katsikas, S. Gritzalis, J. Lopez (Eds.), *Public Key Infrastructure*. XIII, 380 pages. 2004.
- Vol. 3092: J. Eckstein, H. Baumeister (Eds.), *Extreme Programming and Agile Processes in Software Engineering*. XVI, 358 pages. 2004.
- Vol. 3091: V. van Oostrom (Ed.), *Rewriting Techniques and Applications*. X, 313 pages. 2004.
- Vol. 3089: M. Jakobsson, M. Yung, J. Zhou (Eds.), *Applied Cryptography and Network Security*. XIV, 510 pages. 2004.
- Vol. 3087: D. Maltoni, A.K. Jain (Eds.), *Biometric Authentication*. XIII, 343 pages. 2004.
- Vol. 3086: M. Odersky (Ed.), *ECOOP 2004 - Object-Oriented Programming*. XIII, 611 pages. 2004.
- Vol. 3085: S. Berardi, M. Coppo, F. Damiani (Eds.), *Types for Proofs and Programs*. X, 409 pages. 2004.
- Vol. 3084: A. Persson, J. Stirna (Eds.), *Advanced Information Systems Engineering*. XIV, 596 pages. 2004.
- Vol. 3083: W. Emmerich, A.L. Wolf (Eds.), *Component Deployment*. X, 249 pages. 2004.
- Vol. 3080: J. Desel, B. Pernici, M. Weske (Eds.), *Business Process Management*. X, 307 pages. 2004.
- Vol. 3079: Z. Mammeri, P. Lorenz (Eds.), *High Speed Networks and Multimedia Communications*. XVIII, 1103 pages. 2004.
- Vol. 3078: S. Cotin, D.N. Metaxas (Eds.), *Medical Simulation*. XVI, 296 pages. 2004.
- Vol. 3077: F. Roli, J. Kittler, T. Windeatt (Eds.), *Multiple Classifier Systems*. XII, 386 pages. 2004.
- Vol. 3076: D. Buell (Ed.), *Algorithmic Number Theory*. XI, 451 pages. 2004.

Preface

Welcome to the proceedings of the 7th International Conference on Intelligent Tutoring Systems! In keeping with the rich tradition of the ITS conferences, ITS 2004 brought together an exciting mix of researchers from all areas of intelligent tutoring systems. A leading international forum for the dissemination of original results in the design, implementation, and evaluation of ITSs, the conference drew researchers from a broad spectrum of disciplines ranging from artificial intelligence and cognitive science to pedagogy and educational psychology.

Beginning with the first ITS conference in 1988, the gathering has developed a reputation as an outstanding venue for AI-based learning environments. Following on the great success of the first meeting, subsequent conferences have been held in 1992, 1996, 1998, 2000, and 2002. The conference has consistently created a vibrant convocation of scientists, developers, and practitioners from all areas of the field.

Reflecting the growing international involvement in the field, ITS 2004 was hosted in Brazil. The previous conferences were convened in Canada, the USA, and Europe. We are grateful to the Brazilian ITS community for organizing the first ITS conference in Latin America—in Maceió, Alagoas. With its coconut palm-lined beaches and warm, crystal-clear waters, Maceió, the capital city of the state of Alagoas, is fittingly known as “The Water Paradise.” The conference was held at the Ritz Lagoa da Anta Hotel, which is by Lagoa da Anta Beach and close to many of the city’s beautiful sights.

The papers in this volume represent the best of the more than 180 submissions from authors hailing from 29 countries. Using stringent selection criteria, submissions were rigorously reviewed by an international program committee consisting of more than 50 researchers from Australia, Austria, Brazil, Canada, Colombia, France, Germany, Hong Kong, Japan, Mexico, the Netherlands, Portugal, Singapore, Spain, Taiwan, Tunisia, the UK, and the USA. Of the submissions, only 39% were accepted for publication as full technical papers. In addition to the 73 full papers, 39 poster papers are also included in the proceedings. We are pleased to announce that in cooperation with the AI in Education Society, a select group of extended full papers will be invited to appear in a forthcoming special issue of the *International Journal of Artificial Intelligence in Education*.

Participants of ITS 2004 encountered an exciting program showcasing the latest innovations in intelligent learning environment technologies. The diversity of topics discussed in this volume’s papers is a testament to the breadth of ITS research activity today. The papers address a broad range of topics: classic ITS issues in student modeling and knowledge representation; cognitive modeling, pedagogical agents, and authoring systems; and collaborative learning environments, novel applications of machine learning to ITS problems, and new natural language techniques for tutorial dialogue and discourse analysis.

The papers also reflect an increased interest in affect and a growing emphasis on evaluation. In addition to paper and poster presentations, ITS 2004 featured a full two-day workshop program with eight workshops, an exciting collection of panels, an exhibition program, and a student track. We were honored to have an especially strong group of keynote speakers: Stefano A. Cerri (University of Montpellier II, France), Bill Clancey (NASA, USA), Cristina Conati (University of British Columbia, Canada), Riichiro Mizoguchi (Osaka University, Japan), Cathleen Norris (University of North Texas, USA), Elliot Soloway (University of Michigan, USA), and Liane Tarouco (Federal University of Rio Grande do Sul, Brazil).

We are very grateful to the many individuals and organizations that made ITS 2004 possible. Thanks to the members of the Program Committee, the external reviewers, and the Poster Chairs for their thorough reviewing. We thank the Brazilian organizing committee for their considerable effort in planning the conference and making it a reality. We appreciate the sagacious advice of the ITS Steering Committee. We extend our thanks to the Workshop, Panel, Poster, Student Track, and Exhibition Chairs for assembling such a strong program. We thank the General Information & Registration Chairs for making the conference run smoothly, and the Press & Web Site Art Development Chair and the Press Art Development Chair for their work with publicity. Special thanks to Thomas Preuß of ConfMaster for his assistance with the paper review management system, to Bradford Mott for his invaluable assistance in the monumental task of collating the proceedings, and the editorial staff of Springer-Verlag for their assistance in getting the manuscript to press. We gratefully acknowledge the sponsoring institutions and corporate sponsors (CNPq, CAPES, FAPEAL, FINEP, FAL, and PETROBRAS) for their generous support of the conference, and AAAI and the AI in Education Society for their “in cooperation” sponsorship.

Finally, we extend a heartfelt thanks to Claude Frasson, the conference’s founder. Claude continues to be the guiding force of the conference after all of these years. Even with his extraordinarily busy schedule, he made himself available for consultation on matters ranging from the mundane to the critical and everything in between. He has been a constant source of encouragement. The conference is a tribute to his generous spirit.

July 2004

James C. Lester
Rosa Maria Viccari
Fábio Paraguaçu

Conference Chairs

Rosa Maria Viccari (Federal University of Rio Grande do Sul, Brazil)
Fábio Paraguaçu (Federal University of Alagoas, Brazil)

Program Committee Chair

James Lester (North Carolina State University, USA)

Program Committee

Esma Aïmeur (University of Montréal, Canada)
Vincent Alevén (Carnegie Mellon University, USA)
Elisabeth André (University of Augsburg, Germany)
Guy Boy (Eurisco, France)
Karl Branting (North Carolina State University, USA)
Joost Breuker (University of Amsterdam, Netherlands)
Paul Brna (Northumbria University, Netherlands)
Peter Brusilovsky (University of Pittsburgh, USA)
Stefano Cerri (University of Montpellier II, France)
Tak-Wai Chan (National Central University, Taiwan)
Cristina Conati (University of Vancouver, Canada)
Ricardo Conejo (University of Malaga, Spain)
Evandro Barros Costa (Federal University of Alagoas, Brazil)
Ben du Boulay (University of Sussex, UK)
Isabel Fernandez de Castro (University of the Basque Country, Spain)
Claude Frasson (University of Montréal, Canada)
Gilles Gauthier (University of Québec at Montréal, Canada)
Khaled Ghedira (ISG, Tunisia)
Guy Gouardères (University of Pau, France)
Art Graesser (University of Memphis, USA)
Jim Greer (University of Saskatchewan, Canada)
Mitsuru Ikeda (Japan Advanced Institute of Science and Technology)
Lewis Johnson (USC/ISI, USA)
Judith Kay (University of Sydney, Australia)
Ken Koedinger (Carnegie Mellon University, USA)
Fong Lok Lee (Chinese University of Hong Kong)
Chee-Kit Looi (Nanyang Technological University, Singapore)
Rose Luckin (University of Sussex, UK)
Stacy Marsella (USC/ICT, USA)
Gordon McCalla (University of Saskatchewan, Canada)
Riichiro Mizoguchi (University of Osaka, Japan)
Jack Mostow (Carnegie Mellon University, USA)
Tom Murray (Hampshire College, USA)
Germana Nobrega (Catholic University of Brasília, Brazil)
Toshio Okamoto (Electro-Communications University, Japan)

VIII Organization

Demetrio Arturo Ovalle Carranza (National University of Colombia)
Helen Pain (University of Edinburgh, UK)
Ana Paiva (Higher Technical Institute, Portugal)
Fábio Paraguaçu (Federal University of Alagoas, Brazil)
Jean-Pierre Pecuchet (INSA of Rouen, France)
Paolo Petta (Research Institute for AI, Austria)
Sowmya Ramachandran (Stottler Henke, USA)
David Reyes (University of Tijuana, Mexico)
Thomas Rist (DFKI, Germany)
Elliot Soloway (University of Michigan, USA)
Dan Suthers (University of Hawaii, USA)
João Carlos Teatini (Ministry of Education, Brazil)
Gheorge Tecuci (George Mason University, USA)
Patricia Tedesco (Federal University of Pernambuco, Brazil)
Kurt VanLehn (University of Pittsburgh, USA)
Julita Vassileva (University of Saskatchewan, Canada)
Rosa Maria Viccari (Federal University of Rio Grande do Sul, Brazil)
Beverly Woolf (University of Massachusetts, USA)

ITS Steering Committee

Stefano Cerri (University of Montpellier II, France)
Isabel Fernandez-Castro (University of the Basque Country, Spain)
Claude Frasson (University of Montréal, Canada)
Gilles Gauthier (University of Québec at Montréal, Canada)
Guy Gouardères (University of Pau, France)
Mitsuru Ikeda (Japan Advanced Institute of Science and Technology)
Marc Kaltenbach (Bishop's University, Canada)
Judith Kay (University of Sydney, Australia)
Alan Lesgold (University of Pittsburgh, USA)
Elliot Soloway (University of Michigan, USA)
Daniel Suthers (University of Hawaii, USA)
Beverly Woolf (University of Massachusetts, USA)

Organizing Committee

Evandro de Barros Costa (Federal University of Alagoas, Brazil)
Cleide Jane Costa (Seune University of Alagoas, Maceió, Brazil)
Clovis Torres Fernandes (Technological Institute of Aeronautics, Brazil)
Lucia Giraffa (Pontifical Catholic University of Rio Grande do Sul, Brazil)
Leide Jane Meneses (Federal University of Rondônia, Brazil)
Germana da Nobrega (Catholic University of Brasília, Brazil)
David Nadler Prata (FAL University of Alagoas, Maceió, Brazil)
Patricia Tedesco (Federal University of Pernambuco, Brazil)

Panels Chairs

Vincent Alevan (Carnegie Mellon University, USA)

Lucia Giraffa (Pontifical Catholic University of Rio Grande do Sul, Brazil)

Workshops & Tutorials Chairs

Jack Mostow (Carnegie Mellon University, USA)

Patricia Tedesco (Federal University of Pernambuco, Brazil)

Poster Chairs

Mitsuru Ikeda (JAIST, Japan)

Marco Aurélio Carvalho (Federal University of Brasília, Brazil)

Student Track Chairs

Roger Nkambou (University of Québec at Montréal, Canada)

Maria Fernanda Rodrigues Vaz (University of São Paulo, Brazil)

General Information & Registration Chairs

Breno Jacinto (FAL University of Alagoas, Maceió, Brazil)

Carolina Mendonça de Moraes (Federal University of Alagoas, Brazil)

Exhibition Chair

Clovis Torres Fernandes (Technological Institute of Aeronautics, Brazil)

Press & Web Site Art Development Chair

Elder Lima (Federal University of Alagoas, Brazil)

Demian Borba (Federal University of Alagoas, Brazil)

Press Art Development Chair

Elder Lima (Federal University of Alagoas, Brazil)

External Reviewers

C. Brooks

A. Bunt

B. Daniel

C. Eliot

H. McLaren

K. Muldner

T. Tang

M. Winter

Table of Contents

Adaptive Testing

- A Learning Environment for English for Academic Purposes
Based on Adaptive Tests and Task-Based Systems 1
J.P. Gonçalves, S.M. Aluisio, L.H.M. de Oliveira, O.N. Oliveira, Jr.
- A Model for Student Knowledge Diagnosis
Through Adaptive Testing 12
E. Guzmán, R. Conejo
- A Computer-Adaptive Test That Facilitates the Modification
of Previously Entered Responses: An Empirical Study 22
M. Lilley, T. Barker

Affect

- An Autonomy-Oriented System Design for Enhancement
of Learner's Motivation in E-learning 34
E. Blanchard, C. Frasson
- Inducing Optimal Emotional State for Learning
in Intelligent Tutoring Systems 45
S. Chaffar, C. Frasson
- Evaluating a Probabilistic Model of Student Affect 55
C. Conati, H. Maclare
- Politeness in Tutoring Dialogs:
"Run the Factory, That's What I'd Do" 67
W.L. Johnson, P. Rizzo
- Providing Cognitive and Affective Scaffolding Through Teaching
Strategies: Applying Linguistic Politeness to the Educational Context ... 77
K. Porayska-Pomsta, H. Pain

Architectures for ITS

- Knowledge Representation Requirements
for Intelligent Tutoring Systems 87
I. Hatzilygeroudis, J. Prentzas
- Coherence Compilation: Applying AIED Techniques
to the Reuse of Educational TV Resources 98
R. Luckin, J. Underwood, B. du Boulay, J. Holmberg, H. Tunley

The Knowledge Like the Object of Interaction
in an Orthopaedic Surgery-Learning Environment 108
V. Luengo, D. Mufti-Alchawafa, L. Vadcard

Towards Qualitative Accreditation with Cognitive Agents 118
A. Minko, G. Gouardères

Integrating Intelligent Agents, User Models,
and Automatic Content Categorization in a Virtual Environment 128
C. Trojahn dos Santos, F.S. Osório

Authoring Systems

EASE: Evolutional Authoring Support Environment 140
L. Aroyo, A. Inaba, L. Soldatova, R. Mizoguchi

Selecting Theories in an Ontology-Based ITS Authoring Environment ... 150
J. Bourdeau, R. Mizoguchi, V. Psyché, R. Nkambou

Opening the Door to Non-programmers:
Authoring Intelligent Tutor Behavior by Demonstration 162
*K.R. Koedinger, V. Alevan, N. Heffernan, B. McLaren,
M. Hockenberry*

Acquisition of the Domain Structure from Document Indexes
Using Heuristic Reasoning 175
M. Larrañaga, U. Rueda, J.A. Elorriaga, A. Arruarte

Role-Based Specification of the Behaviour of an Agent
for the Interactive Resolution of Mathematical Problems 187
M.A. Mora, R. Moriyón, F. Saiz

Lessons Learned from Authoring for Inquiry Learning:
A Tale of Authoring Tool Evolution 197
T. Murray, B. Woolf, D. Marshall

The Role of Domain Ontology in Knowledge Acquisition for ITSs 207
P. Suraweera, A. Mitrovic, B. Martin

Combining Heuristics and Formal Methods in a Tool
for Supporting Simulation-Based Discovery Learning 217
K. Veermans, W.R. van Joolingen

Cognitive Modeling

Toward Tutoring Help Seeking
(Applying Cognitive Modeling to Meta-cognitive Skills) 227
V. Alevan, B. McLaren, I. Roll, K. Koedinger

Why Are Algebra Word Problems Difficult? Using Tutorial Log Files and the Power Law of Learning to Select the Best Fitting Cognitive Model	240
<i>E.A. Croteau, N.T. Heffernan, K.R. Koedinger</i>	
Towards Shared Understanding of Metacognitive Skill and Facilitating Its Development	251
<i>M. Kayashima, A. Inaba, R. Mizoguchi</i>	
Collaborative Learning	
Analyzing Discourse Structure to Coordinate Educational Forums	262
<i>M.A. Gerosa, M.G. Pimentel, H. Fuks, C. Lucena</i>	
Intellectual Reputation to Find an Appropriate Person for a Role in Creation and Inheritance of Organizational Intellect.....	273
<i>Y. Hayashi, M. Ikeda</i>	
Learners' Roles and Predictable Educational Benefits in Collaborative Learning (An Ontological Approach to Support Design and Analysis of CSCL)	285
<i>A. Inaba, R. Mizoguchi</i>	
Redefining the Turn-Taking Notion in Mediated Communication of Virtual Learning Communities	295
<i>P. Reyes, P. Tchounikine</i>	
Harnessing P2P Power in the Classroom	305
<i>J. Vassileva</i>	
Analyzing Online Collaborative Dialogues: The <i>OXEnTCHÊ-Chat</i>	315
<i>A.C. Vieira, L. Teixeira, A. Timóteo, P. Tedesco, F. Barros</i>	
Natural Language Dialogue and Discourse	
A Tool for Supporting Progressive Refinement of Wizard-of-Oz Experiments in Natural Language	325
<i>A. Fiedler, M. Gabsdíl, H. Horacek</i>	
Tactical Language Training System: An Interim Report	336
<i>W.L. Johnson, C. Beal, A. Fowles-Winkler, U. Lauper, S. Marsella, S. Narayanan, D. Papachristou, H. Vilhjálmsson</i>	
Combining Competing Language Understanding Approaches in an Intelligent Tutoring System	346
<i>P.W. Jordan, M. Makatchev, K. VanLehn</i>	

Evaluating Dialogue Schemata with the Wizard of Oz Computer-Assisted Algebra Tutor	358
<i>J.H. Kim, M. Glass</i>	
Spoken Versus Typed Human and Computer Dialogue Tutoring	368
<i>D.J. Litman, C.P. Rosé, K. Forbes-Riley, K. VanLehn, D. Bhembe, S. Silliman</i>	
Linguistic Markers to Improve the Assessment of Students in Mathematics: An Exploratory Study	380
<i>S. Normand-Assadi, L. Coulange, É. Delozanne, B. Grugeon</i>	
Advantages of Spoken Language Interaction in Dialogue-Based Intelligent Tutoring Systems	390
<i>H. Pon-Barry, B. Clark, K. Schultz, E.O. Bratt, S. Peters</i>	
CycleTalk: Toward a Dialogue Agent That Guides Design with an Articulate Simulator	401
<i>C.P. Rosé, C. Torrey, V. Alevén, A. Robinson, C. Wu, K. Forbus</i>	
DReSDeN: Towards a Trainable Tutorial Dialogue Manager to Support Negotiation Dialogues for Learning and Reflection	412
<i>C.P. Rosé, C. Torrey</i>	
Combining Computational Models of Short Essay Grading for Conceptual Physics Problems	423
<i>M.J. Ventura, D.R. Francheschetti, P. Penumatsa, A.C. Graesser, G.T. Jackson, X. Hu, Z. Cai, and the Tutoring Research Group</i>	
From Human to Automatic Summary Evaluation	432
<i>I. Zipitria, J.A. Elorriaga, A. Arruarte, A.D. de Ilarraza</i>	
Evaluation	
Evaluating the Effectiveness of a Tutorial Dialogue System for Self-Explanation	443
<i>V. Alevén, A. Ogan, O. Popescu, C. Torrey, K. Koedinger</i>	
Student Question-Asking Patterns in an Intelligent Algebra Tutor	455
<i>L. Anthony, A.T. Corbett, A.Z. Wagner, S.M. Stevens, K.R. Koedinger</i>	
Web-Based Intelligent Multimedia Tutoring for High Stakes Achievement Tests	468
<i>I. Arroyo, C. Beal, T. Murray, R. Walles, B.P. Woolf</i>	
Can Automated Questions Scaffold Children's Reading Comprehension?	478
<i>J.E. Beck, J. Mostow, J. Bey</i>	

Web-Based Evaluations Showing Differential Learning for Tutorial Strategies Employed by the Ms. Lindquist Tutor	491
<i>N.T. Heffernan, E.A. Croteau</i>	
The Impact of Why/AutoTutor on Learning and Retention of Conceptual Physics	501
<i>G.T. Jackson, M. Ventura, P. Chewle, A. Graesser, and the Tutoring Research Group</i>	
ITS Evaluation in Classroom: The Case of Ambre-AWP	511
<i>S. Nogry, S. Jean-Daubias, N. Duclosson</i>	
Implicit Versus Explicit Learning of Strategies in a Non-procedural Cognitive Skill	521
<i>K. VanLehn, D. Bhembe, M. Chi, C. Lynch, K. Schulze, R. Shelby, L. Taylor, D. Treacy, A. Weinstein, M. Wintersgill</i>	
Machine Learning in ITS	
Detecting Student Misuse of Intelligent Tutoring Systems	531
<i>R.S. Baker, A.T. Corbett, K.R. Koedinger</i>	
Applying Machine Learning Techniques to Rule Generation in Intelligent Tutoring Systems	541
<i>M.P. Jarvis, G. Nuzzo-Jones, N.T. Heffernan</i>	
A Category-Based Self-Improving Planning Module	554
<i>R. Legaspi, R. Sison, M. Numao</i>	
AgentX: Using Reinforcement Learning to Improve the Effectiveness of Intelligent Tutoring Systems	564
<i>K.N. Martin, I. Arroyo</i>	
An Intelligent Tutoring System Based on Self-Organizing Maps – Design, Implementation and Evaluation	573
<i>W. Martins, S.D. de Carvalho</i>	
Modeling the Development of Problem Solving Skills in Chemistry with a Web-Based Tutor	580
<i>R. Stevens, A. Soller, M. Cooper, M. Sprang</i>	
Pedagogical Agents	
Pedagogical Agent Design: The Impact of Agent Realism, Gender, Ethnicity, and Instructional Role	592
<i>A.L. Baylor, Y. Kim</i>	

Designing Empathic Agents: Adults Versus Kids	604
<i>L. Hall, S. Woods, K. Dautenhahn, D. Sobral, A. Paiva, D. Wolke, L. Newall</i>	
RMT: A Dialog-Based Research Methods Tutor With or Without a Head	614
<i>P. Wiemer-Hastings, D. Allbritton, E. Arnott</i>	
Student Modeling	
Using Knowledge Tracing to Measure Student Reading Proficiencies	624
<i>J.E. Beck, J. Sison</i>	
The Massive User Modelling System (MUMS)	635
<i>C. Brooks, M. Winter, J. Greer, G. McCalla</i>	
An Open Learner Model for Children and Teachers: Inspecting Knowledge Level of Individuals and Peers	646
<i>S. Bull, M. McKay</i>	
Scaffolding Self-Explanation to Improve Learning in Exploratory Learning Environments.	656
<i>A. Bunt, C. Conati, K. Muldner</i>	
Metacognition in Interactive Learning Environments: The Reflection Assistant Model	668
<i>C. Gama</i>	
Predicting Learning Characteristics in a Multiple Intelligence Based Tutoring System	678
<i>D. Kelly, B. Tangney</i>	
Alternative Views on Knowledge: Presentation of Open Learner Models	689
<i>A. Mabbott, S. Bull</i>	
Modeling Students' Reasoning About Qualitative Physics: Heuristics for Abductive Proof Search	699
<i>M. Makatchev, P.W. Jordan, K. VanLehn</i>	
From Errors to Conceptions – An Approach to Student Diagnosis	710
<i>C. Webber</i>	
<i>Discovering Intelligent Agent:</i>	
A Tool for Helping Students Searching a Library	720
<i>K. Yammine, M.A. Razeq, E. Aïmeur, C. Frasson</i>	