Introduction to the Special Issue on Real World Applications of Intelligent Tutoring Systems
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INTelligent Tutoring Systems (ITS) appeared during the 70's, most driven by the success of Knowledge-based Systems and Expert Systems. ITS are able to instruct and train students and professionals without the intervention of human beings. ITS introduced a set of ideas like the use of computational models of domains, allowing the possibility to reason and explain automatically on domain problems. Developments were made in trainees’ models, instructional and pedagogical planning, and user interface. In the 90's, with the web boom, some ITS ideas were incorporated in new computer-aided instruction paradigms, like e-learning and distributed learning. However, there is a clear difference in the level of interactions and types of skills addressed by ITS and other e-learning systems.

ITS are a good example of the use and combination of Artificial Intelligence techniques. Besides expert systems, other areas like natural language, machine learning, planning, multi-agent systems, ontologies, semantic web, social and emotional computing have been used with success in ITS. Other technologies have been applied or combined with ITS, namely multimedia, object-oriented systems, distributed systems, databases, modeling, simulation, statistics, and communications. However, the success of ITS requires attention of other non-technological areas, like Education Sciences, Psychology, and Sociology.

On the last years ITS have moved from research labs into the real world. Many systems were developed and deployed, even for critical and complex domains. The reported benefits demonstrated by the users of these systems are impressive. ITS-taught trainees generally learn faster and translate the learning into improved performance better than classroom-trained participants. Today, ITS can be produced by authoring tools, and specific evaluation and assessment methods can be used.

Since 1988 a conference has been organized every 2 years, the International Conference on Intelligent Tutoring Systems, held recently in Montreal, Canada. Several conferences organize tutorials, workshops, special tracks and sessions dedicated to the ITS topic (e.g. ITS special track in FLAIRS'2008 held in Miami).

The idea to create this Special Issue on Real World Applications of Intelligent Tutoring Systems was to bring together in a single publication some of the most important examples of success in the use of ITS technology. This will serve as a reference to all researchers working in the area. It will also be an important resource for the industry, showing the maturity of the ITS technology and creating an atmosphere for funding new ITS projects. Simultaneously, it will be valuable to academic groups, motivating students for the new ideas of ITS and promoting new academic research work in the area.

From a set of submitted papers with high-quality work, eight have been selected to be included in this special issue.

The paper of Aleven, McLaren and Sewall from the Carnegie-Mellon University describes the use of the Cognitive Tutor Authoring Tools (CTAT) in the creation of Mathtutor, an open-access web site supporting sophisticated tutoring behaviors such as teaching multiple solution strategies, showing dependencies among problem steps, and supporting multiple interpretations of student behavior.

The paper of Feng, N. Heffernan, C. Heffernan, and Mani from the Worcester Polytechnic Institute uses the ASSISTment System with a fine-grained skill model. Experiments with 8th grade students of Mathematics in Massachusetts show that the ITS can predict state scores accurately.

The paper of Papadimitriou, Grigoriadou, and Gytodimos from the University of Athens. This system supports senior students in Greek high schools or students of colleges who are novice in Physics.
(electromagnetism) individually and/or collaboratively, overcoming their misconceptions and learning difficulties.

Computer Science students are faced with some difficulties in programming with some data structures. The work of Fossati, Di Eugenio, Ohlsson, Cosejo, and Chen from the University of Illinois at Chicago, and Brown, from the United States Naval Academy, presents iList, an ITS helping students in learning linked lists and giving explanations for syntax and execution errors.

The paper of Lahart, Kelly, and Tangney from the National College of Ireland present PACT, Parent and Child Tutor, an intelligent tutoring system that addresses the challenge of building an adaptive system, which simultaneously supports both parents and children in the home tutoring environment. The paper focuses on the effect of PACT on parental self-efficacy.

The paper of Faria, Silva, and Vale from the Institute of Engineering – Polytechnic of Porto, and Marques from the Energies of Portugal utility describes the use of Intelligent Tutoring Systems for training Control Centre operators in tasks like incident analysis and diagnosis (DiagTutor), and service restoration (CoopTutor) of Power Systems. The system combines several Artificial Intelligence techniques.

Remolina, Ramachandran, Stottler and Davis, from Stottler Henke Associates, present PORTS TAO-ITS, a deployed Intelligent Tutoring System for the instruction of Tactical Action Officers in training at the Surface Warfare Officers School in Newport, Rhode Island, USA. PORTS TAO-ITS illustrates a simulation-based learn-by-doing tactical system where students interact with simulated teammates.

ASSISTment Builder is a tool designed to effectively create, edit, test, and deploy tutor contents. Razzaq, Patvarczki, Almeida, Vartak, Feng, and Heffernan, from the Worcester Polytechnic Institute, and Koedinger, from the Carnegie-Mellon University, describe the use of this tool for reducing the cost of content creation.

The guest editors of this special issue wish to express their gratitude to all authors that submitted their papers, reviewers that contributed for their reviews and suggestions for improvements of the papers, namely those accepted for this issue. We are also indebted to the Editor in Chief Wolfgang Nedjl and Associate Editor in Chief Peter Brusilovsky for the opportunity to make this special issue a reality and for all the helpful opinions. Marion Wicht deserves our better thanks for facilitating the process. We expect this special issue will be very helpful for IEEE Transactions on Learning Technologies readers, and for Intelligent Tutoring Systems community.

Carlos Ramos got his graduation from the University of Porto, Portugal, in 1986 and the PhD degree from the same university in 1993. He is Coordinator Professor of the Department of Informatics at the Institute of Engineering – Polytechnic of Porto (ISEP-IPT). His main interests are Artificial Intelligence and Decision Support Systems. He is Director of GECAD (Knowledge Engineering and Decision Support Research Centre), the largest R&D centre of the Polytechnic system in Portugal, and dedicated to AI topics. He coordinates the Ambient Intelligence and Decision Support group of GECAD. Carlos Ramos has about 50 publications in scientific journals and magazines and more than 200 publications in Scientific Conferences.

Claude Frasson got his PhD (doctorat d’État) in Informatics in 1981 from the University of Nice in France. Since 1988 he is full Professor in Computer Science at University of Montreal and director of GRITI, a multidisciplinary group involving seven universities in Quebec. He is the founder of the Intelligent Tutoring Systems (ITS) International Conference which is held, every two years. In 1998, he was responsible for the SAFARI project, a very large project supported by the Ministry of Industry, Science, Trade and Technology of Quebec which produced about 70 graduate students. His domains of interests are on brain functioning applied to education and involving emotional intelligence, student modelling and intelligent e-learning. He is Director of the HERON Laboratory, he has more than 300 published papers and 5 books and served as member of the editorial boards of several scientific journals and magazines.

Sowmya Ramachandran received her Ph.D. in Artificial Intelligence from the University of Texas at Austin. At present, she is a research scientist and project manager at Stottler Henke Associates, Inc. Her current research interest is focused on advance educational technology including Intelligent Tutoring Systems, Intelligent Agent for simulations and serious games, authoring tools for ITSs and simulations. An avid learner herself, Dr. Ramachandran is interested in the entire spectrum of human learning, including metacognition and motivation. Experience with military and private industry gives Dr. Ramachandran a unique perspective on the needs and requirements of the ultimate end-users and their constraints. She contributes expertise in AI, instructional systems, probabilistic reasoning, and knowledge management.