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Alexandra I. Cristea · Christos Troussas (Eds.)

Intelligent Tutoring Systems

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Proceedings

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Editors
Alexandra I. Cristea 🆔
Department of Computer Science
Durham University
Durham, UK

Christos Troussas 🆔
University of West Attica
Aigaleo, Greece

Preface

The 17th International Conference on Intelligent Tutoring Systems (ITS 2021) was to be held in Athens, Greece, during June 7–11, 2021. The hosting institution of the ITS 2021 conference was the University of West Attica; however, due to the world-wide COVID-19 pandemic it took place online.

Conforming to the current move of education, work, and leisure online, the title of ITS 2021 was "Intelligent Tutoring Systems in an Online World". Its objective was to present academic and research achievements in Computer and Cognitive Sciences, Artificial Intelligence, and, due to its recent emergence, specifically, Deep Learning in Tutoring and Education. The aim of ITS 2021 was to promote and improve learning technology systems, by combining novel and advanced technology with complex and nuanced research approaches. It offered a forum for exploring emerging and noteworthy progress in the field of Artificial Intelligence in Education.

The call for scientific papers focused on a plethora of topics of interest in the area of ITS and beyond, including the following:

- Intelligent Tutoring
- Learning Environments for Underrepresented Communities
- Artificial Intelligence in Education
- Human in the Loop, Understanding Human Learning on the Web in a Virtual (Digital) World
- Machine Behavior (MB), Explainable AI, Bias in AI in Learning Environments
- Emotions, Modeling of Motivation, Metacognition and Affect Aspects of Learning, Affective Computing and ITS
- Extended Reality (XR), Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) in Learning Technologies
- Informal Learning Environments, Learning as a Side Effect of Interactions
- Collaborative and Group Learning, Communities of Practice and Social Networks
- Analytics and Deep Learning in Learning Systems, Educational Data Mining, Educational Exploitation of Data Mining and Machine Learning Techniques
- Sentiment Analysis in Learning Environments
- Data Visualization in Learning Environments
- Privacy, Security and Ethics in Learning Environments
- Gamification, Educational games, Simulation-based Learning and Serious Games
- Brain-computer Interface Applications in Intelligent Tutoring Systems
- Dialogue and Discourse During Learning Interactions
- Ubiquitous, Mobile, and Cloud Learning Environments
- Virtual Pedagogical Agents and Learning Companions
- Multi-agent and Service-oriented Architectures for Learning and Tutoring Environments
- Single and GroupWise Action Modeling in Learning Environments
- Ontological Modeling, Semantic Web Technologies, and Standards for Learning

- Empirical Studies of Learning with Technologies
- Instructional Design Principles or Design Patterns for Educational Environments
- Authoring Tools and Development Methodologies for Advanced Learning Technologies
- Domain-specific Learning Technologies, e.g. Language, Mathematics, Reading, Science, Medicine, Military, and Industry
- Non-conventional Interactions between Artificial Intelligence and Human Learning
- Personalized and Adaptive Learning Environments
- Adaptive Support for Learning, Models of Learners, Diagnosis and Feedback
- Recommender Systems for Learning
- Causal Modeling and Constraints-based Modeling in Intelligent Tutoring

The call for papers sought papers that presented significant new research findings in the use of advanced computing technology and interdisciplinary research to allow, promote, and enhance human learning. Full papers allowed for discussion of more mature and finalized research results, whilst short papers allowed discussions around brief novel findings. There was also a posters track, which included an excellent network for researchers to discuss research prototypes and work in progress to conference attendees.

The international Program Committee consisted of 63 leading members of the Intelligent Tutoring Systems community (20 senior and 43 regular), as well as highly promising younger researchers. Scientific papers were reviewed by three to five reviewers through a double-blind process. Only 25% of the submitted papers, were accepted as full papers, about 24% were accepted as short papers, and just 15% were accepted as posters. These percentages indicate that ITS 2021 was a top-flight, rather selective, high-quality conference.

A separate Doctoral Consortium (DC) offered a forum for Ph.D. students to present and discuss their research when it was still in the early stages of development, engage colleagues with similar goals, and collaborate with more senior members in the community (mentors). The Doctoral Consortium Chairs were Mizue Kayama, Shinshu University (Japan), and Mike Joy, University of Warwick (UK).

The full papers outlined some very important developments, the short papers explored some fascinating new theories, and the posters discussed research in progress that needs particular attention, all based on the ITS philosophy.

The main topics under which the accepted papers fall, on which basis we also structured this book, are as follows:

- **Theory** – comprising Theory and Reviews; Models; Concept Maps
- **Learner focus** – including Student Prediction; Learner Behavior; Feedback and Personalization; Groups, Teams, Social, Crowd and Communities Assessment
- **Future ITS orientation** – bringing together Games and Gamification; Emotions and Affect; and xtended Reality

A variety of new techniques had been introduced or revisited, including multimodal affective computing, XR, mixed-compensation multidimensional item response, ensemble deep learning, cohesion network analysis, conversational agent, semantic web,

computer-supported collaborative learning, and social networking in education. The rigor of the research was high, and it revealed several generalizable findings. Furthermore, it created space for the use of approaches like retrospective trials, experimental research, and meta-analysis, which might include new insights at future ITS conferences.

The quality of a conference is reflected by the work of its participants as well as their ability to push the boundaries, and the rigor with which they encourage the rest of the research field to move beyond. The papers of ITS 2021 stretched the limits of intelligent tutoring, much as they had in the previous years. Reinforcement learning, artificial neural networks, semantic web technologies, natural language processing, social networking, digital assistants, and recommender systems were among the fields where they had documented remarkable work.

The ITS 2021 program was reinforced by the successful organisation of a Workshop: "Intelligent Tutor Demonstrations" by Mihai Dascalu, Amruth Kumar, and Daniela M. Romano, and two half-day Tutorials: "Learning Analytics Hands-On Tutorial" by Alexandra Cristea and "Data Science for Learning Process Management" by Filippo Sciarrone. They were all selected and managed by the Workshop and Tutorial Chairs, Amruth Kumar, Ramapo College of New Jersey (USA), Mihai Dascalu, University Politehnica of Bucharest (Romania), and Daniela Romano, University College London (UK).

We would like to express our thanks to many different contributors in the midst of the overwhelming and unforeseen circumstances of the COVID-19 pandemic.

The successful preparation and implementation of the ITS 2021 conference was secured by the original work of all the authors, the devoted contribution of the various Conference Chairs, the members of the Program Committee, and the Steering Committee, in particular its Chair, Claude Frasson. The organization, coordination, and online operation of ITS 2021 achieved by the Local Organizers and the Organization Chair, Kitty Panourgia. We would also like to address our special thanks to the Conference Sponsor, the "Education Sciences" journal (MDPI), for its support. Last but not least, we would like to acknowledge the Institute of Intelligent Systems (IIS) under the auspices of which this conference was held.

Rather than concluding this preface, we would like to emphasise that one of the main outcomes of the ITS 2021 conference is a fusion of new and established scholars, innovative and highly evolved subjects, theoretical developments and business interests, broadening of areas and deepening of subgenres. This equilibrium is an utterly necessary dimension. We hope you enjoy reading the papers and using them towards generating new ideas – and citing them in your own research!

April 2021   Alexandra Cristea
                                                                   Christos Troussas

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