Lecture Notes in Artificial Intelligence 10331

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Artificial Intelligence in Education

18th International Conference, AIED 2017
Wuhan, China, June 28 – July 1, 2017
Proceedings
Preface

The 18th International Conference on Artificial Intelligence in Education (AIED 2017) was held from June 28 to July 1, 2017, in Wuhan, China. AIED 2017 was the latest in a longstanding series of biennial international conferences for high-quality research in intelligent systems and cognitive science for educational computing applications. The conference provides opportunities for the cross-fertilization of approaches, techniques, and ideas from the many fields that comprise AIED, including computer science, cognitive and learning sciences, education, game design, psychology, sociology, linguistics, as well as many domain-specific areas. Since the first AIED meeting over 30 years ago, both the breadth of the research and the reach of the technologies have expanded in dramatic ways.

There were 121 submissions as full papers to AIED 2017, of which 36 were accepted as long papers (12 pages) with oral presentation at the conference (for an acceptance rate of 30%), and 37 were accepted for poster presentation with four pages in the proceedings. Of the 17 papers directly submitted as poster papers, seven were accepted. Apart from a few exceptions, each submission was reviewed by four Program Committee (PC) members including one senior PC member serving as a meta-reviewer. In addition, submissions underwent a discussion period to ensure that all reviewers’ opinions would be considered and leveraged to generate a group recommendation to the program chairs.

Four distinguished speakers gave plenary invited talks illustrating prospective directions for the field: Ronghuai Huang (Beijing Normal University, China), Sanya Liu (Central China Normal University, China), Antonija “Tanja” Mitrovic (University of Canterbury), and Riichiro Mizoguchi (Japan Advanced Institute of Science and Technology, Japan). The conference also included:

- A Doctoral Consortium that provided doctoral students with the opportunity to present their ongoing doctoral research at the conference and receive invaluable feedback from the research community.
- An Interactive Events session during which AIED attendees could experience first-hand new and emerging intelligent learning environments via interactive demonstrations.
- An Industry and Innovation Track intended to support connections between industry (both for-profit and non-profit) and the research community. The participating companies presented the need of and involvement with educational technologies with five (out of nine accepted) industry papers and engaged with AIED researchers to learn about the most promising new developments in the field and connect with academic partners.
AIED 2017 hosted four workshops focused on providing in-depth discussion of current and emerging topics of interest to the AIED 2017 community, including:

- Second International Workshop on Intelligent Mentoring Systems: Linking Learning in Real and Virtual Environments
- Workshop: Sharing and Reusing Data and Analytic Methods with LearnSphere
- Workshop: How Do We Unleash AIEd at Scale to Benefit all Teachers and Learners?
- Workshop: Turn Theories into Products: Implementation of Artificial Intelligence in Education

In parallel with the workshops, two tutorials presented advanced topics and current developments that have a level of maturity in AIED research.

The conference was co-located with EDM 2017, the 10th International Conference on Educational Data Mining, and shared some workshops with it.

We offer our most heartfelt thanks to our colleagues at Central China Normal University for hosting AIED 2017. We also wish to acknowledge the considerable effort by our colleagues at the Ateneo de Manila University in making this conference possible. We would also like to thank Marija Filimonovic from Augsburg University for providing excellent support when editing the proceedings. Special thanks goes to Springer for sponsoring the AIED 2017 Best Paper Award and the AIED 2017 Best Student Paper Award.

We also want to acknowledge the amazing work of the AIED 2017 Organizing Committee, the senior PC members, the PC members, and the reviewers (listed herein), who with their enthusiastic contributions gave us invaluable support in putting this conference together.

April 2017

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Keynotes
A Conceptual Framework
for Smart Learning Engine

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Abstract. In a life-long learning society, learning scenarios can be categorized into five types, which are “classroom learning”, “self-learning”, “inquiry learning”, “learning in doing” and “learning in working”. From a life-wide learning perspective, all these scenarios play vital roles for personal development. How to recognize these learning scenarios (including learning time, learning place, learning peers, learning activities, etc.) and provide the matched learning ways (including learning path, resources, peers, teachers, etc.) are the basis for smart learning environments, however few research could be found to address this problem.

In order to solve this problem, we propose a conceptual framework of smart learning engine that is the core of integrated, interactive and intelligent (i³) learning environments. The smart learning engine consists of three main functions.

The first function is to identify data from student, teacher, subject area, and the environment using wireless sensors, the established learning resources and scenarios, and a learner modeling technology. The acquired data includes prior knowledge, theme-based context, learner/teacher profile, physical environments, etc.

The second function is to compute the best ways of learning based on the learning scenario and learning preference. In detail, this function includes modeling learner’s affective data, building knowledge structure, optimizing knowledge module, and connecting learners.

The third function is to deploy personalized and adaptive strategy, resources and tools for students and teachers based on the computed results in the second function. Deploy interactive strategies, learning paces, learning resources, and delivery approaches are the core elements for this function.
Quantified Learning

Liu Sannyuya
Central China Normal University, Wuhan, China

Abstract. Emerging technologies, including internet of things and big data, are leading to educational revolutions in learning environment, learning applications, and learning approaches. Recent advancement in data collection and data analysis offers opportunities in accurate description and quantification of learning activities. Quantified Learning refers to the process of utilizing appropriate approaches and methods to gain insights from students’ explicit and implicit behavioral features, and offering analysis and intervention services to accommodate students’ personalized learning needs. With “learner-centered” philosophy, Quantified Learning will develop data-oriented perception and effectively facilitate knowledge construction and personal development. With data, learners, stakeholders, and connected learning services, Quantified Learning is a closed-loop with adaptive feedbacks. The four stages of quantified learning, including quantification, data collection, integration and analysis, and intelligent services will enhance research and practices of teaching and learning with more accuracy and intelligence.
From Databases to Prospective Memory:  
The Saga of CBM Continued

Antonija Mitrovic

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Abstract. Twelve years ago, I presented an invited talk at AIED 2005, which  
focused on the early days of the Intelligent Computer Tutoring Group\(^1\). (ICTG),  
and the tutors we developed. Our early work focused on teaching design tasks,  
such as database querying and design. Since then, we have employed CBM  
successfully in many other domains. Some of those tutors also taught design  
tasks, such as Java programs and UML design, while other were procedural in  
nature. We also developed ASPIRE, an authoring system and deployment  
environment for constraint-based tutors. ASPIRE has served as the foundation  
for developing new tutors, ranging from teaching how to solve thermodynamics  
problems, manage oil palm plantations, diagnosing problems with X ray images.  
ASPIRE allowed embedding constraint-based tutors into other software pack-  
ages, such as accounting software and management information systems. It also  
allowed having sophisticated interfaces, such as the Augmented Reality inter-  
face of MAT. During these 12 years, we were successful in developing a  
constraint-based model of collaborative skills, modeling meta-cognitive skills  
and affect of our students. We also investigated feedback strategies, especially  
the effect of how feedback is phrased on learning, and the effect of positive  
feedback. The most recent studies focused on multiple teaching strategies:  
comparing learning from problem-solving, worked examples, and erroneous  
examples. And then we investigated whether we can model prospective memory  
using constraints; in a recently completed project, the prospective memory  
functioning of 15 stroke survivors increased significantly after 10 sessions of  
computer-based training on how to memorize prospective tasks, and practising  
in a Virtual Reality environment. In this talk, I will present highlights of our  
recent projects.

\(^1\) www.ictg.canterbury.ac.nz.
An AI Methodology and a New Learning Paradigm

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Abstract. My talk consists of two topics: One is how ontology engineering as an AI methodology helps you modeling of AIED matters and the other is Negotiation-Driven Learning: NDL as a new learning paradigm. After reviewing several AI methodologies, I discuss ontology engineering to explain that it is a promising methodology and it contributes to modeling rather than to metadata. I will try convince you that it provides a powerful conceptual tool to tackle and handle complex objects/concepts /theories/systems/etc. It also enables you to design systems with clear separation between domain-dependent and domain-independent parts, which is exploited in the research on NDL. NDL is a new learning paradigm in OLM, in which I have been intensively involved with my former PhD student, Raja Suleman recently. It is a framework built by integrating dialog-based tutoring, interest-based negotiation and affective computing in the negotiation process of OLM. I will discuss its role in AIED in terms of learning paradigm and methodology of system design.

Keywords: Modeling · Ontology engineering · Negotiation-driven learning
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