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Artificial Intelligence in Education

19th International Conference, AIED 2018
London, UK, June 27–30, 2018
Proceedings, Part I

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Preface

The 19th International Conference on Artificial Intelligence in Education (AIED 2018) was held during June 27–30, 2018, in London, UK. AIED 2018 was the latest in a longstanding series of (now yearly) 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.

For the 2018 conference on Artificial Intelligence in Education, we were excited to have a co-located event, the "Festival of Learning," together with the International Conference of the Learning Sciences (ICLS) and "Learning at Scale" (L@S). The festival took place in London (UK) during June 24–30. Since the days of landmark tutoring systems such as SCHOLAR and WHY decades ago, the fields of artificial intelligence, online learning, and the learning sciences have grown up side-by-side, frequently intersecting, synergizing, and challenging one another. As these fields have grown and matured, they have each experienced trends and waves, and each has seen a recent renewal that we celebrate in this year's conference. In artificial intelligence, the most recent renewal is in the emerging area of deep learning, where advances in computing capacity both in terms of memory and processing speed have facilitated a resurgence of interest in neural network models, with greater capacity than in the last neural network revolution. In the learning sciences, a recent emphasis on scaling up educational opportunities has birthed new areas of interest such as massive open online courses, which are also an important focus for the L@S community. In this year's conference we considered these recent renewals together and asked how advances in artificial intelligence can impact human learning at a massive scale. More specifically we asked how the fields of artificial intelligence and learning sciences may speak to one another at the confluence, which is the field of artificial intelligence in education. Thus, the theme of this year's conference was "Bridging the Behavioral and the Computational: Deep Learning in Humans and Machines."

There were 192 submissions as full papers to AIED 2018, of which 45 were accepted as long papers (12 pages) with oral presentation at the conference (for an acceptance rate of 23%), and 76 were accepted for poster presentation with four pages in the proceedings. Of the 51 papers directly submitted as poster papers, 15 were accepted. Apart from a few exceptions, each submission was reviewed by three Program Committee (PC) members including one senior PC member serving as a meta-reviewer. The program chairs checked the reviews for quality, and where necessary, requesting that reviewers elaborate their review or shift to a more constructive orientation. Our goal was to encourage substantive and constructive reviews without

interfering with the reviewers' judgment in order to enable a fair and responsible process. 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. Final decisions were made by carefully considering both scores and meta-reviews as well as the discussions, checking for consistency, weighing more heavily on the meta-review. We also took the constraints of the program into account and sought to keep the acceptance rate within a relatively typical range for this conference. It was a landmark year in terms of number of submissions, so the acceptance rate this year was lower than it has been in recent years, although the number of accepted papers was substantially higher. We see this as a mark of progress – something to be proud of as a community.

Three distinguished speakers gave plenary invited talks illustrating prospective directions for the field: Tom Mitchell (Carnegie Mellon University, USA), Paulo Blikstein (Stanford University, USA), and Michael Thomas (Birkbeck, University of London, UK). The conference also included:

- A Young Researchers Track that provided doctoral students with the opportunity to present their ongoing doctoral research at the conference and receive invaluable feedback from the research community.
- Interactive Events sessions 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.

AIED 2018 hosted one full-day and nine half-day workshops and tutorials on the full gamut of topics related to broad societal issues such as ethics and equity, methodologies such as gamification and personalization, as well as new technologies, tools, frameworks, development methodologies, and much more.

We wish to acknowledge the great effort by our colleagues at the University College London in making this conference possible. Special thanks goes to Springer for sponsoring the AIED 2018 Best Paper Award and the AIED 2018 Best Student Paper Award. We also want to acknowledge the amazing work of the AIED 2018 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 2018

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The original version of the frontmatter of this book was revised, the version supplied here includes updated "Organization" information.

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Abstracts of Keynotes

What if People Taught Computers?

Tom Mitchell

Carnegie Mellon University, USA
tom.mitchell@cmu.edu

Abstract. Whereas AIED focuses primarily on how computers can help teach people, this talk will consider how people might teach computers. Why? There are at least two good reasons: First, we might discover something interesting about instructional strategies by building computers that can be taught. Second, if people could teach computers in the same way that we teach one another, suddenly everybody would be able to program. We present our ongoing research on machine learning by verbal instruction and demonstration. Our prototype Learning by Instruction Agent (LIA) allows people to teach their mobile devices by verbal instruction to perform new actions. Given a verbal command that it does not understand (e.g., "Drop a note to Bill that I'll be late."), the system allows the user to teach it by breaking the procedure down into a sequence of more primitive, more understandable steps (e.g., "First create a new email. Put the email address of Bill into the recipient field."…). As a result, LIA both acquires new linguistic knowledge that enables it to better parse language into its intended meaning, and it learns how to execute the target procedure. In related work with Brad Meyers we are exploring combining verbal instruction with demonstration of procedures on the phone, to achieve "show and tell" instruction. In work with Shashank Srivastava and Igor Labutov, we are extending the approach to general concept learning (e.g., in order to teach "if I receive an important email, then be sure I see it before leaving work." one must teach the concept "important email."). This talk will survey progress to date, implications, and open questions. This work involves a variety of collaborations with Igor Labutov, Amos Azaria, Shashank Srivastava, Brad Meyers and Toby Li.

Time to Make Hard Choices for AI in Education

Paulo Blikstein

Stanford University, USA
paulob@stanford.edu

Abstract. The field of AI in education has exploded in the past ten years. Many factors have contributed to this unprecedented growth, such as the ubiquity of digital devices in schools, the rise of online learning, the availability of data and fast growth in related fields such as machine learning and data mining. But with great power comes great responsibility: the flipside of the growth of AIED is that now our technologies can be deployed in large numbers to millions of children. And while there is great potential to transform education, there is also considerable risk to destroy public education as we know it, either directly or via unintended consequences. This is not an exaggeration: in recent months, we have indeed learned that the combination of social media, technological ubiquity, AI, lack of privacy, and under-regulated sectors can go the wrong way, and that AI has today a disproportionate power to shape human activity and society.

On the other hand, most schools of education around the world are not equipped – or not interested – in this debate. They either ignore this conversation, or simply attack the entire enterprise of AI in education—but these attacks are not stopping wide dissemination of various types of AIED projects in schools, mainly driven by corporations and fueled by incentives that might not work in the benefit of students (i.e., massive cost reduction, deprofessionalization of teachers, additional standardization of content and instruction).

In this scenario, the academic AIED community has a crucial responsibility—it could be the only voice capable to steering the debate, and the technology, towards more productive paths. This talk will be about the hard choices that AIED needs to face in the coming years, reviewing the history of AI in education, its promise, and possible futures. For example, should we focus on technologies that promote student agency and curricular flexibility, or on making sure everyone learns the same? How do we tackle new learning environments such as makerspaces and other inquiry-driven spaces? What is the role of physical science labs versus virtual, AI-driven labs? How can AIED impact—positively and negatively—equity in education?

I will review some of these issues, and mention examples of contemporary work on novel fields such as multimodal learning analytics, which is trying to detect patterns in complex learning processes in hands-on activities, and new types of inquiry-driven science environments.

The AIED community is strategically placed at a crucial point in the history of education, with potential to (at last) impact millions of children. But the way forward will require more than technical work—it will require some hard choices that we should be prepared to make.

Has the Potential Role of Neuroscience in Education Been Overstated? Can Computational Approaches Help Build Bridges Between Them?

Michael Thomas

University College London/Birkbeck University of London, UK
m.thomas@bbk.ac.uk

Abstract. In the first part of this talk, I will assess the progress of the field of educational neuroscience in attempting to translate basic neuroscience findings to classroom practice. While much heralded, has educational neuroscience yielded concrete benefits for educators or policymakers? Is it likely to in the future? Or is its main contribution merely to dispel neuromyths? In the second half of the talk, I will assess the role that computational approaches can play in this inter-disciplinary interaction. Is neuroscience best viewed as a source of inspiration to build better algorithms for educational AI? Or can neurocomputational models help us build better theories that link data across behaviour, environment, brain, and genetics into an integrated account of children's learning?

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