Life-Long Learning, Learner Models and Augmented Cognition

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Abstract. Our field of Intelligent Tutoring Systems has long been inspired by the vision of achieving huge improvements in learning via expert personalised teaching. As we now see computers become ubiquitous and pervasive, we can broaden that vision to include new ways to learn what we need to know, when we need to know it, throughout our lives. In this 20th anniversary of the ITS conferences, we can see that the future will bring an ITS vision that is broadened to include augmented cognition, where systems provide, not only teaching, but also the means to augment our memory by facilitating access to information as needed, be that as mediated contact with other people or access to our own external memory, a collection of the things we want to be able to re-find or remember as needed.

Central to this vision is the life-long learner model because it bears the responsibility for modelling relevant aspects of the learner so that an ITS can help us access the information we need to meet our needs. This talk draws on the foundations of ITS work to create a view of the nature of that life-long learner model, the processes of life-long learner modelling and the ways that an ITS can make use of these. The talk illustrates the vision in terms of representations of learner models, user interface and other practical concerns such as privacy.

1   ITS as a Grand Challenge Problem

The ITS research community has been driven by the importance of the human need to learn and to access information. We now have a long track record of work towards understanding how to push the limits of technology in support of improved learning. This draws on both improved understanding of learning and human cognition and equally, on creating new ways to build software systems that are effective aids for learning.

More recently, there has been clear recognition of the importance of our vision and goals as well as the challenges in achieving them. In 2002, the Computing Research Association (CRA) identified five Grand Research Challenges in Computer Science and Engineering[1]. One of these, *Provide a Teacher for*

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[1] http://www.cra.org/grand.challenges/

Every Learner, matches the ITS goal of personalised teaching. Subsequently, the United Kingdom Computing Research Committee (UKCRC) identified nine Current Grand Challenges for Computing[2]. One of these GC8, *Learning for Life*, recognises the importance of the multidisciplinary research that is already a strong part of the ITS tradition. Another, GC3, *Memories for Life* is also closely aligned ITS research. In the last year, another peak body, the National Academy of Engineering identified 14 wide-ranging grand challenge problems. One of these is *Advance personalized learning*[3], which recognises the importance of research into technology to support instruction that "can be individualized based on learning styles, speeds, and interests to make learning more reliable". This, too, is directly aligned with the goals of the ITS community. This talk will explore two key aspects that are at the core of a research agenda that tackles these grand challenge research problems.

2   Life Long Learner Models

Learner models are at the heart of the personalisation of ITSs [1]. For life-long learning, we need to explore ways to build life-long learner models. These have the potential to track learning progress over long periods and across the range of sources of evidence about the learner's progress.

This talk will explore some of the issues that arise as we move towards such models. Some of these have already had considerable attention within our community. Notably, there has been wide recognition of the importance of interoperability, where there can be effective communication between ITSs. The talk will review approaches based on semantics and standardisation efforts and how these appear to provide some potential foundations for ensuring that a meaningful long term learner model can draw upon information that is harvested by the range of learning systems, as well as other software, that a person may use throughout their life. The talk will examine ways we will be able to make use of both conventional learning tools and environments, such as learner management systems (LMSs) as well as ITSs, with their especially rich information about the learners. The talk will explore alternative lines of research that can enable us to exploit the vast quantities of electronic traces of learner activity within conventional software. Taking the example of an LMS, we can, on the other hand, explore the challenges on enhancing it with learner models. Alternatively, we can make post-hoc interpretations of the vast data available from such tools, the electronic traces that learners leave through their interaction. These have huge potential to provide invaluable evidence for a rich life-long learner model. Another key is the human-in-the-loop approaches, particularly open, transparent and scrutable learner models. Our research agenda for life-long learner models must also make meaningful progress on privacy management for these models.

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[2] http://www.ukcrc.org.uk/grand_challenges/current/index.cfm
[3] http://www.engineeringchallenges.org/cms/8996/9127.aspx

3   Life-Long Augmented Memories

The ubiquity and pervasive nature of computers has the potential to have important impact on the our learning needs and goals because we may be able to rely on technology to augment our memories. This talk will explore key directions for research which takes account of this ubiquitous nature of computing: approaches to just-in-time learning, delegation of *remembering* to the computer and ways that electronically mediated collaboration can support remembering by indirection, aided by other people. Our focus will be on the links between such augmented cognition and life-long learner models.

Reference

1. Self, J.: The defining characteristics of intelligent tutoring systems research: ITSs care, precisely. International Journal of Artificial Intelligence in Education 10(3-4), 350–364 (1999)