Adaptive Tutoring System With Application of Intelligent Agents

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ABSTRACT

In this article, the authors suggest a methodology to adapt learning units to the needs and talents of individual students using an intelligent learning system. Learning personalisation is done based on several factors. Felder and Silverman Learning Styles model is used to create student’s profile with conjunction of data mining technologies and previously recorded behaviour of the student. Firstly, the authors perform systematic review of application of intelligent software agents in teaching throughout Clarivate Analytics Web of Science database. Secondly, they present methodologies to personalise learning by means of intelligent technologies. They analyse preferences of students according to Soloman-Felder Learning Styles questionnaire. The resulting model of a student is used in the creation of a personalised learning unit. The model of an adaptive intelligent teaching system based on application of aforementioned technologies is presented in more detail.

KEYWORDS

Intelligent Software Agents, Learning Styles, Learning Units, Ontologies, Personalised Intelligent Multi-Agent Learning System, Recommender System, Semantic Web

1. INTRODUCTION

Personalisation of learning and application of intelligent technologies in education became very popular topics in scientific literature during last few years (Juškevičiene & Kurilovas, 2014). The authors of (Kurilovas, Zilinskiene, & Dagiene, 2015) think that there is no concrete definition of personalisation so far. The core idea of adaptive personalisation is to achieve a common goal, to provide students with what they require without expecting them to ask for it explicitly. Because of the multi-faceted nature of the problem that includes recommendation systems, customisation, adaptive Web sites, and Artificial Intelligence, a universal definition that would cover all its theoretical and technological areas has not been proposed so far. From the educational viewpoint, personalisation attempts to provide an individual with tailored products, services, information, etc. A more technical standpoint to personalisation is linked with the modelling of Web objects (products and pages) and subjects (users) as well as their categorisation organising them to achieve the desired personalisation.

Personalisation can be seen from two different perspectives, namely, while only one learning object (LO) (Kurilovas, Juskevičiene, Kubilinskiene, & Serikoviene, 2014) or a learning unit / scenario

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(Dagiene & Kurilovas, 2007) is selected, and while a set of them is composed, i.e. personalisation of a learning unit by finding a learning path. The former perspective formulates LO selection problem, and the latter one solves curriculum sequencing problem.

According to (Lytras & Kurilovas, 2014), intelligent technologies such as semantics, ontologies and semantic web systems are on the road for a long journey. The problems that have been realized in the last years were only a first wave of human scepticism.

In the paper, first of all, systematic review on intelligent software agents’ application in education is performed. Second, methodologies (1) on personalising learning applying intelligent technologies and (2) on creating optimised learning units for particular learners are presented. Third, the novel model of personalised intelligent multi-agent learning system is presented.

In the paper, an intelligent agent is referred to a piece of software that assists people and act on their behalf. Intelligent agents work by allowing people to delegate work that they could have done, to the agent software. Agents can perform repetitive tasks, remember things you forgot, intelligently summarize complex data, learn from you and even make recommendations to you.

The rest of the paper is organised as follows: Section 2 presents systematic review, Section 3 presents methodologies to personalise learning by means of intelligent technologies and to creating optimised learning units for individual students, Section 4 presents the model of personalised intelligent multi-agent learning system, and Section 5 concludes the paper.

2. SYSTEMATIC REVIEW

In order to identify the latest results in application of intelligent multi-agent systems in education, basic systematic literature review method has been used (Kitchenham, 2004). The intention of the scientific review was to answer the question: “What are the latest contributions to application of intelligent agents in education?” Systematic literature review was performed on 25 September 2016 in Clarivate Analytics (former Thomson Reuters) Web of Science database. Search history can be seen in Figure 1. In the last two years (2014-2016), thirty-four Articles were published on the topic “intelligent multi-agent* system AND learning”. The main factor for choosing papers for the review from the search results was their relevance to education, as multi-agent systems have a variety of applications. After applying systematic review methodology, on the last stage, ten suitable papers were identified for further analysis of the topic.

The purpose of the (Duffy & Azevedo, 2015) study was to examine whether pedagogical agents’ scaffolding (instructional prompts and feedback) would impact learners’ self-regulated learning processes and achievement in MetaTutor learning environment. Authors also aimed to better
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