AI Group
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ABSTRACT
In this work, the identity, the research areas and the directions as well as the research achievements of the Artificial Intelligence Group of the Laboratory of Graphics, Multimedia & Geographical Information Systems in the Department of Computer Engineering & Informatics of the University of Patras related to the area of Adaptive Educational Hypermedia Systems are presented.

KEYWORDS: *Knowledge Representation in Adaptive Educational Hypermedia Systems, AI techniques in adaptive hypermedia systems*

DESCRIPTION OF RESEARCH GROUP

Artificial Intelligence (AI) Group (http://mmlab.ceid.upatras.gr/aigroup/) is an informal group within the Laboratory of Graphics, Multimedia & GIS of the Department of Computer Engineering & Informatics of the University of Patras. The Computer Engineering & Informatics Department (CEID) of the University of Patras is one of the more active and famous departments of the University with more than 25 academic staff members, 20 external teaching staff persons, 1000 undergraduate and 200 postgraduate students. Director of the Lab is Professor Athanassios Tsakalidis. Leader of the AI Group is Dr Ioannis Hatzilygeroudis, who is a Lecturer at the Department. Dr Ioannis Hatzilygeroudis (http://mmlab.ceid.upatras.gr/aigroup/ihatz/) holds a PhD from the University of Nottingham, UK. His PhD thesis was in the area of Knowledge Representation (KR) Languages, where he designed a KR language that combines logic and objects/frames. He is teaching the 'Artificial Intelligence', 'AI Programming' and 'Introduction to Programming II (Java)' undergraduate courses and the 'Artificial Intelligence', 'Intelligent Decision Systems' and 'Knowledge Representation' postgraduate courses.

The rest of the group consists of the following persons: Dr Jim Prentzas, who recently got his PhD from our Department. His thesis was related to 'neurules' a new KR scheme combining symbolic rules and neural units. Dr Constantinos Koutsojannis, who has got a PhD in Medical Physics from the University of Patras and is now studying for his 2nd PhD in the area of Medical Expert Systems in our Department. Mr Christos Giannoulis, who is a postgraduate student, in its second year of studies, dealing with a student modeling application in his postgraduate thesis. He is planning to do a PhD in the area of Intelligent Web-Based Educational Systems. Also, there are

two new-comers in the group, Mr Themis Chronopoulos, a PhD student aiming at a thesis in the area of Intelligent Collaborative Web-Based Educational Systems, and Mr George Barboboulos, a PhD student aiming at a thesis in the area of Intelligent Web-Based Educational Systems. Also, there are three postgraduate students doing their postgraduate theses: Mr Eleftherios Keramydas dealing with transforming a Theorem Prover into an education and research tool, Mr Panagiotis Hountis dealing with applying agent technology to a Web-based AI teaching system and Mrs Anna Moshopoulou dealing with KR in the semantic web, especially the use of ontologies in a web-based educational system.

RESEARCH INTERESTS

The basic research direction of the group concerns knowledge representation (KR) and expert systems (ESs), especially hybrid representations and systems, that is representation schemes that combine more than one single scheme and systems that integrate more than one AI technique. A basic KR scheme is symbolic rules, which constitute the most widely used formalism for KR in ESs, so that the so-called 'expert system approach' often implies the use of a rule-based representation and reasoning approach. Therefore, one of our research directions concerns hybrid KR approaches based on rules. One of our results has been 'neurules', a knowledge representation and reasoning scheme combining symbolic rules and neural units.

Recently, we've started to use intelligent educational systems (IESs), such as Intelligent Tutoring Systems (ITSs), either web-based or not, as our application area, i.e. an area to apply our basic research results to. On the other hand, that application area has started to guide our basic research: to design KR schemes for IESs. So, our main research interests in adaptive educational hypermedia systems (AEHSs) is related with the use of KR schemes in them. This research direction is more KR-oriented than AEHSs-oriented at the moment. The main open problems/questions we are trying to solve/answer are: (a) Hybrid vs single KR schemes: which category is better for which component of an IES? Does it play any role in the architecture of a system? and (b) Can we specify KR requirements for IESs?

To have an answer to (a), we applied 'neurules' to a web-based ITS (basically to its pedagogical component) and evaluated its benefits, as far as knowledge representation and acquisition are concerned, compared to classical symbolic rules. We concluded that neurules are more beneficial than single symbolic rules. We also resulted in a system architecture based on an expert system. We presented our results at ICALT-01 (Prentzas et al, 2001), ITS-02 (Prentzas et al, 2002). Also published them in the International Journal of Expert Systems with Applications (Hatzilygeroudis & Prentzas, 2004a).

To answer question (b), we made a first effort to specify KR requirements coming from both the system components (user model, pedagogical unit, domain knowledge) and the system users (tutors, engineers, learners) based on a theoretical analysis. We resulted in a number of rather general KR requirements. Given them and having in mind question (a), we tried to compare existing KR formalisms based on how much they satisfy those requirements. The results of our analysis are that (a) hybrid schemes are in general more beneficial than single ones and (b) even a hybrid scheme is not adequate for KR for all the components. Our results will be presented at ITS-04 (Hatzilygeroudis & Prentzas, 2004b).

Another direction of our research, the most recent, is related to *Adaptable Educational Hypermedia Systems*. The main question(s) to answer here is(are) related to the "adaptability vs adaptivity" issue. Is an adaptive system always better than an adaptable one? Is adaptability by itself adequate for some systems? Do we need both (adaptability and adaptivity) in a system? To answer the question(s), we constructed an educational hypermedia system for teaching aspects of AI, such as first-order logic as a KR language. The system provides an implicit content presentation order, but a student can follow his/her own order. In the first version of the system,

adaptability was related to student self-evaluation. A student could choose the type and the level of difficulty of exercises and make a self-evaluation by comparing his/her answers with those of the system. In its second version, we added what we call 'open exercising facility', where a student can try any possible logic formula conversion, in a step-wise manner, from a first-order logic form to another. This has been achieved by attaching part of a Theorem Prover (a logic-based system implemented in LISP) at some point of the hypermedia application, thus providing a window to an open system. This version of the system (http://mmlab.ceid.upatras.gr/aigroup/aits/) was used in the 2003-2004 winter semester to support the 'AI' course in our Department and reception from the students was quite promising. Incorporation of an open system in the hypermedia system was proved to be very beneficial. Our results will be presented at ICALT-04 (Hatzilygeroudis et al 2004).

FUTURE RESEARCH TARGETS

The above system is the beginning of our research towards our effort to answer the question(s) of our second research direction. Its next version will include adaptivity capabilities. For example, one evolution of the system would be the introduction of a user model and use of AI techniques to be able to provide adaptive behavior such as adaptive curriculum sequencing and/or adaptive content presentation and/or problem solving support etc. Then the effectiveness of the system will be compared to the previous version. Comparison will be based on different parts of the domain knowledge and different levels of adaptability and adaptivity, since different parts may require different levels of adaptability or adaptivity.

Regarding our first direction of research, we have the following research targets. (a) We realized, from our first effort, that a more detailed and profound analysis of each component of an IES should be made as far specification of KR requirements is concerned. The KR requirements should be made more specific and more IES-oriented. (b) A finding of our research in specifying KR requirements for e.g. the user modeling component is representation of fuzziness. So, we are planning to improve the neurules KR scheme to be able to represent fuzziness. (c) A disadvantage of the expert system based architecture of the ITS is the difficulty to use different KR schemes in different components of the system. Use of an intelligent agent-based architecture seems to solve the problem and give more flexibility to the system. This is going to be investigated.

ΒΙΒΛΙΟΓΡΑΦΙΑ

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