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GENETIC ALGORITHMS FOR COURSEWARE ENGINEERING

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Abstract. *The process for creating learning contents using reusable learning objects (LOs) can be broken down into two sub-processes: LO finding and LO sequencing. Finding can be automated by the use of federated search engines along with gap analysis techniques; however, sequencing is usually performed by instructors, who create courses targeting generic profiles rather than personalised materials. This paper proposes a novel technique for courseware engineering that aims to solve two recurrent problems in this area: automation of the instructor's role and personalised course building. Simultaneously, e-learning standards are promoted in order to ensure interoperability. Competencies and metadata are used to define relations between LOs so that the sequencing problem turns into a constraint satisfaction problem and a genetic algorithm is designed and implemented to solve the sequencing problem. The proposed agent is tested in real and simulated scenarios. Results show that it succeeds in all test cases and that it handles reasonably the computational complexity inherent in this kind of problem.*
Keywords: E-learning, Learning object, Courseware engineering, Sequencing, Genetic algorithm, Evolutionary computation

1. **Introduction.** Brusilovsky envisaged Web-based adaptive courses and systems able to achieve certain important features including the ability to substitute for teachers' and other students' support, and the ability to adapt to (and so be used in) different environments by different users (learners). These systems may use a wide variety of techniques and methods. Among them, curriculum sequencing technology is designed 'to provide the student with the most suitable individually planned sequence of knowledge units to learn and sequence of learning tasks [...] to work with' [1]. These methods are derived from the adaptive hypermedia field [2] and rely on complex conceptual models, usually driven by sequencing rules [3,4]. E-learning traditional approaches and paradigms that promote reusability and interoperability are generally ignored, thus resulting in adaptive but proprietary systems (such as AHA! [5]) and non-portable courseware.

On the other hand, traditional approaches promote standards usage to ensure interoperability but they lack flexibility, which is in increasing demand. 'In offering flexible [e-learning] programmes, providers essentially rule out the possibility of having instructional designers set fixed paths through the curriculum' [6]. Offering personalised paths to each learner, however, will impose prohibitive costs on these providers, because the