Personalized e-learning system using learner profile ontology and sequential pattern mining-based recommendation

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Abstract - E –learning is a method of learning that is delivered via electronic technology. Most of the E – Learning systems do not consider the individual aspects of the students ignoring the various requirements of the learners. Personalization is widely used in various fields to provide users with more suitable and personalized service. Personalization of E – Learning system is a method of improving the existing learning system to satisfy the requirements of the different users / learners. Success of E- Leaning system rests on the effective usage of the system by the instructors and the students. This paper suggests a method for personalizing the E _ learning system using learner profile and sequential pattern mining based recommendation.

Keywords: E-Learning System, Personalization, learner profile, Sequential pattern mining.

I. Introduction

E-Learning, or better computer supported learning focuses on the individual's acquisition (or rather construction) of new knowledge and the technological means to support this construction process. One of the main assumptions in e-learning coming from pedagogy is that learning needs or can be improved through guidance. The typical form of guidance is the teacher or tutor organizing the learning process. But e- learning has also transferred the concept of lessons to computer-based courses, consisting of several learning resources that are connected with one another in a meaningful way. Learning systems can be categorized into two different classes based on the mode of learning. The two categories are 1) Collaborative learning 2) Adaptive learning. In collaborative learning, the learning would be the acquisition of knowledge, skills, or attitudes by individuals occurring as a result of group interaction, or put more tersely, individual learning as a result of group process. The idea that collaborative learning is the development of shared meaning among group members reflects the larger CSCL (Computer Supported Collaborative Learning) perspective on learning, a perspective that emphasizes the social creation of knowledge as the basis of learning [7]. In adaptive learning, the learning system is usually a web-based application program that provides a personalized learning environment for each learner, by adapting both the presentation and the navigation through the learning content. Such a learning environment can dynamically reorganize learning resources to meet specific learning objectives based on an individual learner's profile or learning portfolio [8].

The issue of personalization in E-learning or adaptive e-learning has become an important topic of research in recent years. With the emergence of Web-based learning systems, it has become possible to provide access to content to wider learner community, and hence open up learning opportunities for those who typically are not able to avail formal education. However, such wider access has raised challenging issues with respect to providing adequate learning experiences to different learners, since Web-based learning systems generally did not adapt content to suit individual learner needs [10]. Generally, personalization in e-learning systems concerns: adaptive interaction, adaptive course delivery, content discovery and assembly, and adaptive collaboration support. The category of adaptive course delivery represents the most

common and widely used collection of adaptation techniques applied in e-learning systems today. Typical examples include dynamic course re-structuring and adaptive selection of learning objects, as well as adaptive navigation support, which have all benefited from the rise of using recommendation strategies to generate new and relevant links and items. In fact, one of the new forms of personalization in e-learning environment is to give recommendations to learners in order to support and help them through the e-learning process [9].

During the last few years, the work on the Semantic Web brought new ideas in setting up a new form of web content that is meaningful to computers [1]. Several technologies have been developed for constructing and developing the Semantic Web. RDF (Resource Definition Framework) [2] and its extensions such as OWL [3] have been developed to define metadata schemas, domain ontologies and resource descriptions. Since the personalization in E-learning environment requires the provision of knowledge and learning contents in various forms, there is a need for semantic-based annotation of the e-learning material, easy restructuring of the e-learning design, and individualized delivery of the e-learning material [4, 6]. The vision of the Semantic Web is the ability to express World Wide Web information in a natural and formal language that can be interpreted by intelligent agents, thus permitting them on behalf of the human user to locate, share and integrate information in an automated way. It provides a framework for dynamic, distributed and extensible structured knowledge (ontology) founded on formal logic. Ontology is an explicit specification of a conceptualization using an agreed vocabulary and provides a rich set of constructs to build a more meaningful level of knowledge. Ontologies and their associated reasoners are the building blocks of the Semantic Web initiative [5]. Moreover, recent developments of semantic web technologies have shown a trend of using ontologies to promote personalized learning which allows us to create specific user profiles and content models.

II.   Review of Related Works

Literature presents several techniques for e-learning using ontology and user's preference. Here, we review some of the techniques. Sarma Cakula *et al.* [11] have developed a personalized e-learning Model Using Methods of Ontology. Their motto is to discover overlapping points of KM and e-learning phases to enhance the structure and transfer of personalized course knowledge by means of effective methods of ontology and metadata standards. Their research offered a theoretical background of knowledge management principle execution for the development of a practical personalized e-learning technique. Yevgen Biletskiy *et al.* [12] have proposed a technique to apply personalized search of learning objects to build up ontological techniques of the learner and learning objects and techniques for determination and adjustment of the learner's choice using related ontologies. For this reason they have chosen criteria of estimation of suitability of learning objects to the learner profile and presented coefficients of significance of these criteria and a technique for adjusting these coefficients.

Haiyang Jia *et al.* [13] have designed a performance-oriented workplace e-learning system by means of ontology to solve the issue of gaps amid organizational interests and individual requirement in e-learning. They set up Key performance indicators to elucidate organizational training requirements and aid learners set up rational learning objectives. Moreover, they exploited ontology to develop formal and machine-comprehensible conceptualization of the performance-oriented learning environment. Using this approach they developed Key performance indicators based learning ontology and prototype system and it was assessed to demonstrate the effectiveness of the approach. Mehmet Ali Salahli *et al.* [14] have presented fuzzy Knowledge Management System for personalized learning by considering the factors such as learners' profiles, learning materials and learning strategies. The major motto of their system is to offer the most appropriate learning materials to the learners by taking account of their knowledge level and other learning characteristics. The knowledge base of their system includes course and concepts ontologies, learners' profiles and learning objects knowledge. They applied fuzzy logic techniques to express and process the knowledge. Their preliminary experimental outcomes exposed the operability of their system.

M. Gaeta *et al.* [15] have presented an advanced ontology management system for personalized e-Learning. Ontologies can be exploited to model educational domains and to build, organize and update exact learning

resources in e-Learning field. One of the major issues of educational domains modeling is the lacking of proficiency in the knowledge engineering field by the e-Learning actors. Therefore they presented an integrated approach to deal with the life-cycle of ontologies which is exploited to define personalized e-Learning experiences supporting blended learning activities without any exact proficiency in knowledge engineering. Sergey Sosnovsky *et al.* [16] have presented an ontology based personalization of open corpus learning material. Limitless source of learning material for any subject can be exploited from WWW by teacher and students. Such an abundance of content comes with an issue of identifying right piece at right time. Conventional adaptive educational systems cannot prop up personalized access to open-corpus learning material as they depend on manually constructed content models. Therefore they presented a technique to that issue that does not need human intervention. Their technique has been carried out in an adaptive system that endorses students complementary reading material and adaptively annotates it. The outcomes of their technique demonstrated a number of significant effects of exploiting the system on students' learning.

Fathi Essalmi *et al.* [17] have proposed a new technique for personalization of learning scenarios based on two stages. The first stage consents the personalization of learning scenarios based on a predefined personalization strategy. The second stage consents teachers to select personalization parameters and merge them flexibly to define dissimilar personalization strategies according to the specifics of courses. Their proposed solution is a step to unite the research efforts on the E-learning personalization by integrating and joining the personalization parameters. Concerning the technological feature, Web service technology makes up an operational solution for employing their approach and for the interoperability with other E-learning personalization systems. They also aimed to offer proper personalized learning scenarios. Ahmad Baylari *et al.* [18] have proposed a personalized multi-agent e-learning system by means of item response theory (IRT) and artificial neural network (ANN). They presented adaptive tests derived from IRT and personalized recommendations derived from ANN. These agents adjoin adaptivity and interactivity to the learning environment and perform as a human instructor which directs the learners in a friendly and personalized teaching environment.

III. Proposed Methodology

E-learning is a recent development happened in educational system due to the growth of information technology. The challenge involved in e-learning platform are, i) Collection and storing of learning materials, ii) modeling of user behavior for personalization. iii) Recommending the relevant learning style sequentially, iv) the retrieval and delivery of useful learning materials from the storage space in a more significant way. In order to handle these challenges, the proposed system will be developed using five different steps.

(i) Learning contents module: The module presents the storage for all essential learning materials in the format of text, video or audio. Here, data management technique will be used to organize all the learning material effectively.

(ii) Profile ontology module: The learner profile is stored as ontology with a well defined structure and information. This information will be useful to predict the learner's behavior, and thereby adapt to his/her individual needs.

(iii) Dynamic learner modeling: The learner's behavior of selecting learning style, time spent and score obtained can be stored as log file. This log file will be useful for recommending the learning style and also, providing the learning materials adaptively and timely.

(iv) Adaptive recommendation module: This module provides the learning contents to the learner adaptively or personalized way based on the ontology and sequential pattern. The sequential patterns will be mined using PrefixSpan algorithm from usage log data. These sequences were then used to generate recommendations to further select the learning style by the users.

(v) Instructor module: This module performs the online tutoring for every learner based on the protocol designed using the above modules.

The implementation will be done through JAVA programming and protégé tool and the performance will be analyzed.

IV.   Conclusion

Success of any learning system is not only based on the usability of the system for the users and also on the way how it is adaptable to the various users . The suggested model recommends better data management technique for organizing the course content effectively. It also predicts the learner's behavior to deliver the course content according to the leaner's individual needs.

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