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Personalized recommender system for e-Learning environment based on student's preferences and evaluation of teachers peer

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Information	Abstract
Key Word Recommendation systems Collaborative filtering particle swarm optimization K-nearest neighbors.	At the present time, new technologies and the rapid development of the Internet have made access to information easier for all class of people, but create new challenges for education when they use the Internet as a tool, which has created a need for new techniques to help users find their interest; these techniques are called Recommendation Systems (RSs). These systems will adapt the learning experience according to the goals of the individual learner. In this paper, we present a recommender e-learning approach which utilizes one of recommendation techniques to identifying preferences of learners and employing particle swarm optimization algorithm to find optimal scenario proposed by their teachers during the formation and the scenario which has high weight is recommended to another teacher during the conception of his scenario, taking into account the measure of similarity between these teachers.
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Introduction

Technology Enhanced learning is the application of information and communication technologies for teaching and learning [1]. Recommendation Systems (RSs) are software tools based on machine learning and information retrieval techniques [2] in other words, it can be defined as programs which attempt to recommend the most suitable items to particular users by predicting a user's interest in an item based on related information about the items, the users and the interactions between items and users. Most of the modern e-Learning systems are still producing the same educational resources in the same way to learners with various profiles [3]. Recommendations represent an important role in an adaptive e-Learning system. This needs learner profile due to different preferences, learning activities between learners. Moreover, it is very challenging for a teacher to decide the best learning strategy for each learner and to apply it in a real

classroom and also the current e-Learning systems are not providing a better facility to track the learner's progress. It leads learners to interact less with the e-Learning system or keep out from e-Learning. One way to address this problem is to use recommender system techniques which can help e-learning by automatically recommending the most suitable learning scenario to the learners according to their personalized preferences and profile. In this way we propose a recommendation system approach to recommend a pedagogical scenario dedicated to teachers in the phase of designing a pedagogical scenario for learners in the e-learning context which is adapted to the learner's profiles. In this work we propose a CF-PSO-KNN by employing collaborative filtering method and particle swarm optimization algorithm to find optimal individual pedagogical scenario. After finding suitable weights of scenario, we compute similarities between teachers by utilizing K-nearest

neighbors to recommend the scenario which is adapted to the learner's profiles.

Literature review

Dianping, Lakshmi and al. [4] propose a new method named by item-based collaborative filtering technique to generate a new recommender item list. They ask to find the relation between different items compared to a user-item rating matrix to see the similarities.

A novel hybrid-filtering recommender system proposed by M.R. Lee and al. [5]. They using machine learning and Facebook Fan Page data. This technique solves cold start and accuracy problems and increase customer satisfaction.

A new hybrid recommender system for learning materials was proposed by Salehi and al. [6] to improve the accuracy and quality of recommendations. This system is consisting of two modules. The first module considers weights of implicit attributes of learners' material as chromosomes in genetic algorithm and then these weights of learners are optimized according to historical rating after which recommendations are generated using Nearest Neighborhood Algorithm. The second module uses a Preference Matrix to model learner's interests based on explicit attributes of learning materials.

Ghazanfar and Prugel-Bennett [7] propose a hybrid recommender system using and combining all recommender system techniques. This technique has advantages of all techniques, this technique used to eliminate redundant records problems with the recommendation system.

In this paper [8] a new model named by iExpand was proposed by Liu and al. to makes recommendations by exploiting the information about user's latent interests.

In 2013 [9] a personalized recommendation model was proposed by to shows three social factors: personal interest, interpersonal interest similarity and interpersonal influence, these factors are combined with a unified personalized recommendation model based on probabilistic matrix factorization.

A social contextual recommendation model (contextMF) was proposed by Jiang and al. [10] to

prove that individual preference is a major factor in social network to make recommendations.

Aher & Lobo [11] proposed recommendation system to recommend particular MOODLE courses for learners based on enrolled classes by a combination of machine learning approaches and they also combined algorithm (Clustering, Simple K-Means, and Apriori Association Rule Algorithm). They proposed a data mining recommendation process based on historical data.

Ogwoka et al [12] proposed hybrid method to evaluate the student model based on data like attendance lesson tests, student enrolment status by using a J48 decision tree and Simple K-means based model.

logic recommender system was proposed by Almohammadi and al. [13] [14] to improves e-learning adaptability to the learner taking into account the detection of the level of student engagement through the Kinect 3D camera that identifies student engagement learner facing the direction and emotions without portable electronics. The fuzzy rules recommended pedagogical approach most appropriate as PowerPoint explanation, questions and answers, examples.

In this paper [15] a personalized e-learning recommender system, called PERS, was proposed to suggest adaptive classroom materials that meet the student's needs based on the group's preferences. The cold start problem is solved by using a static questionnaire for each new student base. This system is based on collaborative filtering recommendation

2. Background

Recommendation Systems

Recommendation systems can largely neutralize the effect of information overload by filtering out the vital information portion of a large amount of dynamically generated information. The recommendation system is smart enough to predict a user's preference for one item over another [16].

The recommendation system takes into consideration a set of multiple factors to provide good recommendations. It includes the type of data available for the system, the algorithm used for filtering, the model used, the technique used including Bayesian networks, genetic algorithms,

probabilistic approaches, the nearest neighbor strategy. The results of the recommendation system are also affected by the performance system, the dissemination of the database, the objective of the system and finally the quality of the results targeted by the system [11]. According to Venkatesan and al. [16] Recommender system can be considered as a decision support tool for obtaining optimal recommendations for the use of resources or services based on the personalization or preferences of the user concerned. The idea behind (RSs) is to collect information about user preferences for a set of articles according to their activities and their social belonging (movies, songs, books, jokes, gadgets, applications, websites and e-learning platform). The RSs mainly use three filtering methods to provide personalized recommendations to users; the most popular ones are collaborative filtering (CF), content-based filtering and hybrid filtering. Collaborative filtering approaches employ community data such as comments, ratings, or clicks from other users to build recommendations. Content-based approaches make recommendations using content features to identify similar items or determine the similarity between items and the user's profile. Hybrid approach combines several of these methods to profit from their advantages and refrains from their limitations.

Collaborative filtering

The recent widespread increase in information available on the Internet, further accelerated by social media, has raised the need for systems that can help users find valuable information. In this context, filtering information based on CF can help users in their searches. It is widely based on human psychology of a person who asks his friends and family for suggestions on something they own, so it helps the person to make a decision. This technique is one of the most dominant techniques that have ever been confirmed, and works with collecting data from a large amount of users, it plays an important role in the recommendation process. Collaborative filtering operates by collecting and analyzing a large amount of information about user behaviors, activities, preferences, and exploiting the evaluation similarities between users to determine how to recommend an item [15]. CF uses the opinions of users similar to the active user. It is the phenomenon that users with similar tastes and choices in the past tend to agree in the future with unrated items. The CF system represents users with

their notes on a set of articles. The CF system selects a set of similar users based on a measure of similarity or correlation. Then, it generates rating forecasts for items not rated by the target user. Finally, the system recommends the items with the highest expected ratings [17]. Three major steps are needed to accomplish the recommendation task in CF.

- Collection of data for creation of a user profile
- Neighborhood set generation
- Predictions and recommendations

As an example, consider that there are two users: user1 and user2 if user1 likes element {A, B, C}, and user2 element {A, B, C, D}, then according to the similar choices of {A, B, C} between two users. The D element is recommended to User1 because both User1 and User2 have the maximum similarity of the {A, B, C} element. Both users, therefore, see themselves as users of similar taste. Collaborative filtering is considered the most popular and prevalent method in RS. Although Collaborative filtering is frequently used along with other filtering techniques like content-based.

Particle swarm optimization

Particle swarm optimization (PSO) is a population based evolutionary technique like genetic algorithms. It differs in that each particle or solution contains a position, velocity and acceleration. The velocity and acceleration change the position of the particle to explore the space of all possible solutions, instead of using crossover and mutation to generate new offspring. As particles move around the space, they sample onto different locations. Each location has a fitness value according to how good it is at satisfying the objective. Because of the rules governing the swarming process, particles will eventually swarm around the area in the space where fittest solutions are. Every particle possesses its respective velocity and position and initial population of particle initialized randomly. The velocity and particle position is updated by following the two best values in the problem space. The first best value is the best solution (fitness) of the particle achieved so far which is called particle best denoted by "pbest". The other best value is the best value obtained so far by any particle. This best value is called global best denoted by "gbest". [18]

The steps of the PSO algorithm are:

Procedure PSO ()

Initialize parameters;

Initialize swarm;

Evaluate the Performance of particles;

Do

{

Find the personal best;

Find the global best;

Update the velocity;

Update the position;

Evaluate the Performance of particles;

}

While (Termination criterion not satisfied);

K nearest neighbors

K-Nearest Neighbors (KNN) is one of the most basic yet essential classification algorithms in Machine Learning. KNN is a simple algorithm that stores all the available cases and classifies the new data or case based on a similarity measure. The idea of the KNN algorithm is: if the majority of the k most similar neighbors of model in the feature space belongs to a certain group, so the model is considered to belong to this group [19].

Our proposition

Today, social networks have become essential tools in the lives of students. The different interactions generate immeasurable information on the profiles of the learners, their choices, their habits, their preferences...

One of the difficulties encountered by educational designers is the design of a pedagogical scenario which is adapted to the learner's profiles.

The aim of our proposition is to recommend a pedagogical scenario dedicated to teachers in the phase of designing a pedagogical scenario for learners in the e-learning context.

The approach described in this paper is based around a collaborative filtering approach, building up profiles of users that contains rating of pedagogical scenarios proposed by teachers, demographic data (age, gender, and preferences), and implicit data about user behavior, then employing particle swarm optimization algorithm to find optimal pedagogical scenario which is evaluated by learners and teachers peer and the scenario which has high weight is recommended to another teacher during the conception of his scenario, taking into account the measure of similarity by employing K-nearest neighbors between these teachers we also based on the principle of:

Social influence: two friends can have the same interests

Co-citation regularity: if they have some similarities in common, they will be more likely to have the same interests.

The proposed approach relies on three types of data:

Profile data that describe learners

Rating data that describe the evaluations of learners and teachers peer

Social data that describe links between users

The peer teacher evaluation covers:

- ❖ Learner satisfaction. This allows knowing the perception concerning the quality of organization.
- ❖ The level of acquisition of the learners
- ❖ The teaching methods used in training
- ❖ Clear objectives, realistic and achievable
- ❖ Short sequences
- ❖ Varied teaching methods
- ❖ The adequacy between the teaching methods used and the objectives of the activity

Conclusion and future work

Recommendation system (RS) is a type of information filtering system that gives advice on products' information, or services that a user may be interested in. RSs were used, among the many solutions available to mitigate the information problems and cognitive overload by providing users with related and relevant elements. Existing RSs mainly use feedback from users and their similarities to offer them adequate resources for their needs. In this paper, we present a recommender e-learning approach which utilizes one of recommendation techniques to identifying preferences of learners and employing particle swarm optimization algorithm to find optimal individual scenario proposed by their teachers during the formation and the scenario which has high weight is recommended to another teacher during the conception of his scenario, taking into account the measure of similarity between these teachers.

Our future work is to experiment our approach in real E-learning context on a large amount of learners and teachers to test the effectiveness of our proposed approach.

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