Intelligent recommendation systems: Literature review on recommendation techniques and their use in education

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Abstract - Today's information systems are characterized by increasing volume and complexity. Data sources and the way information is structured are heterogeneous and not sufficiently adapted to needs. This makes access to relevant information so difficult. Recommendation tools provide data to facilitate the search for content based on the user's experience. Machine Learning algorithms, data and behavior analysis and semantic technologies are used by these systems to find relevant results based on user preferences. This literature review aims to identify the purpose and techniques of a recommender system, the role, the approaches, the applications and the future prospects of recommendation system in education.

Keywords - Recommendation system, Collaborative filtering, Machine learning, Content based, Hybrid filtering

I. INTRODUCTION

Recommender systems are extremely useful in helping users solve the problem of information overload. These systems provide users with the most appropriate content, using data about their previous preferences. They are tools that facilitate interaction with vast and complex information spaces. They sort the elements that might be of interest to the user in order to offer a personalized view from a large number of possible options[1]. With the progress of artificial intelligence and deep learning, recommendation systems have become so intelligent that they are capable of understanding complex user choices. However, despite their undeniable advantages, intelligent recommendation systems also raise ethical questions and technical challenges, such as privacy protection and recommendation transparency.

II. GENERAL CONTEXT

A. Definition and background

Recommender systems are a technique that produces individualized recommendations to guide the user in a personalized way[2], allowing data to be filtered and useful, relevant information to be found according to the user's preferences. In other words, recommender systems enable users to make better choices from among the various contents available in information systems.

Recommender systems use various artificial intelligence techniques, such as machine learning algorithms, filtering and classification methods, text analysis, text mining, semantic technologies and more.

Since 1990, recommender systems have evolved considerably, gaining in popularity due to the rapid growth of Internet technology, which has generated a growing volume of heterogeneous data [3]. Targeting user-relevant information is therefore crucial to the success of many searches. As a result, recommendation systems are used in many fields, including e-commerce such as Amazon, eBay and Alibaba, e-learning such as Coursera and Udemy, social networking such as Facebook, Linkedin and Twitter, and accommodation such as Booking.

B. Aims of the recommendation system:

1) Seek to increase sales:

Use recommendations to sell more items than traditional sales. The system recommends items that are supposed to satisfy the user's tastes and needs. There is a difference between predicting users' interests in an item and the probability that users will actually buy the recommended item [4].

2) Diversifying the choice of items sold:

The aim here is to make unknown items and items without recommendations appear. The aim is to spread the recommendation across the entire catalogue, and not just limit it to the most popular items.

3) Ranking a list of items:

Provide certain good items to the current user, according to the rating predictions. In other words, recommend items that the user should like.

4) Improved browsing:

Given a large catalogue, the task of a SR can improve the user's browsing experience by helping them find items that match their tastes and needs.

5) Ensure consistency of recommendations:

Provide a consistent suite of recommendations rather than relying on standalone items [5].

C. Recommender system techniques :

Recommender systems are advanced software applications that analyse data in order to propose recommendations to users. There are three main types of approach used in these

systems: collaborative filtering, content-based filtering and hybrid filtering [2].

1) Collaborative filtering:

Is based on the user's previous interactions with the recommended items, as well as the ratings given by the user. For example, if a user has enjoyed several adventure films, the system can recommend similar films based on the preferences of other users who share the same tastes[6][7].

2) Content-based filtering:

Focuses on the attributes of the recommended items, such as their genre or subject. E.g. if a user likes documentaries on space, the system can recommend other documentaries on similar themes [6][7].

To provide more precise and diversified suggestions, hybrid filtering combines the two previous approaches. For example, first the identification of users similar to the current one is carried out, then content-based filtering is used to recommend items corresponding to their specific preferences.
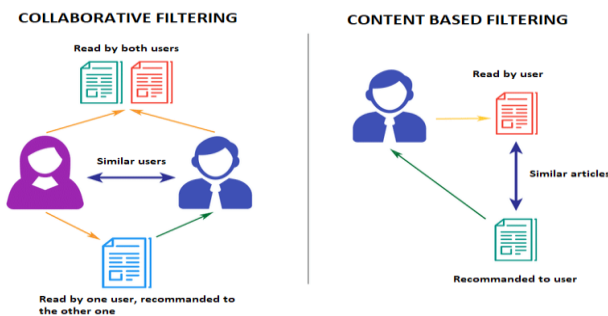

Fig 1: The difference between Collaborative Filtering and Content Based Filtering

3) Hybrid filtering :

Combines the two previous approaches to offer more precise and diversified suggestions[8]. E.g, by first identifying users who are similar to the current user, and then using content-based filtering to recommend items that match their specific preferences.

Fig 2 : Hybrid Recommendation System

III- RECOMMENDATION SYSTEMS FOR EDUCATION :

A. Recommender systems for education : approaches

An educational recommender system is a computer application used in education to provide personalized information to learners, teachers and other stakeholders. [9] These systems use data analysis and machine learning to understand users' needs, preferences and performance, in order to recommend the most relevant educational resources, such as online courses, learning modules, educational videos, articles and books. The main aim of these systems is to improve the learning experience by making it easier to find resources tailored to the specific needs, skill level and learning style of each learner [1]. In addition, teachers can use these systems to select effective learning resources, monitor students' progress and give them personalized feedback. In short, learning recommendation systems are technological tools that facilitate access to appropriate learning resources and improve the quality of teaching by offering personalized information and suggestions.

1) Recommender systems for education: John R. Anderson's approach

In his "Cognitive Tutor" theory research, J. Andreson [9] has shown that a recommender system can be designed to:

- Monitor learners' actions.
- Identify gaps in understanding.
- Provide personalised examples to help overcome difficulties (Anderson et al, 1995).

2) Recommender systems for education: the approach of Peter Brusilovsky et al (2007)

The work of Perter Brusilovsky et al (2007)[10] explored different approaches to personalize a recommendation system for education, using the techniques of :

- Modeling the learner's interests.
- Analysis of similarity between users.
- Recommending resources based on past learning behaviour.

The table below explains the difference between recommender systems for shopping and recommender systems for education:

Recommendation for purchase	Recommendation for education
- Seek to increase sales. - Diversify the choice of items sold. - Recommend lists of items that users should like. - Improve navigation.	- Adapt to the needs of each learner. - Take into account the level of mastery, knowledge and skills of each learner. - Manage the abundance of courses available online - Helping to overcome learning difficulties

Table 1. The difference between recommendation systems for sales and recommendation systems for education

B. Applications of recommender systems in education:

Intelligent recommendation systems are widespread in the field of education. They offer personalized, adaptive recommendations to learners, teachers and schools. They use data analysis and pedagogical objectives to improve the efficiency, personalization and accessibility of education at all levels.

1) Improve learner's performance:

Recommender systems study learners' preferences and past performance to provide them with tailored educational content recommendations. They also identify learners' skills and gaps and suggest personalized learning paths, suggesting additional topics, exercises and resources.

2) Specific feedback & Social learning:

Teachers can leverage these systems to provide personalized feedback on learner performance, while learners can connect with like-minded colleagues, facilitating collaboration and social learning.

3) Career guidance and institutional policy:

Recommendation systems help learners make academic choices based on their interests and career goals. By analyzing data on learner performance, these systems facilitate decision-making at institutional level, helping to improve programs and policies.

C. Recommendation systems in education : future prospects

The future prospects for improving recommendation systems in education involve several key points[11]:

1) Invest in research to increase the accuracy of recommendations made to learners.

2) Develop techniques to identify and reduce algorithmic bias in recommendation systems.

3) Investigate methods that protect user privacy while enabling effective individualization of the educational experience.

4) Integrate advanced artificial intelligence technologies to better meet learners' needs.

5) Encourage the creation of pedagogical tools integrating recommendation systems to offer personalized learning paths.

6) Set up training and awareness programs for educators and decision-makers.

7) Encourage collaboration between different research players with a view to developing global solutions for exploiting recommender systems in education.

IV. CONCLUSION

In this article, we have explored the broad field of recommender systems, whose application in the field of education is the subject of particular attention. First, we defined recommender systems as technological tools capable of offering personalized suggestions to users based on their preferences and interaction history. Reviewing the historical background to the development of these systems, we highlighted their evolution and explored the different techniques used in recommender systems, including collaborative filtering, content-based filtering and hybrid approaches combining several techniques.

Secondly, we examined the fundamental aims of recommender systems, their specific approaches, and discussed concrete applications of these systems in education, including learner performance, feedback, social learning, and institutional policy guidance.

Finally, we looked at the future prospects for recommender systems in education, highlighting areas of research focused on improving accuracy and integrating advanced artificial intelligence techniques. In conclusion, recommender systems offer immense potential for improving education by providing personalized and adaptive recommendations to learners. By continuing research and development in this area, and exploring new approaches and applications, we can continue to advance the use of these systems to create more effective, personalized and inclusive educational experiences for all learners.

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