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E-Learning Course Recommendation: Combining Content Filtering and Sentiment Analysis

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***Abstract*— As e-learning becomes more popular, there is a greater demand for personalized and effective online course recommendation systems. In this study, we offer an e-learning online course recommendation system that analyses course reviews and organizes them based on their scores. Based on the content filtering, the algorithm then recommends the optimal route to the user. To do this, we collected data from several e-learning sites and analysed the reviews using natural language processing (NLP) techniques. The courses were then recommended using a content-based filtering technique based on their resemblance to the user's interests and past course selections. Sentiment analysis determines whether a given text contains emotions that are negative, positive, or neutral [15]. In terms of accuracy and user satisfaction, our trials reveal that our suggested system beats existing state-of-the-art recommendation systems. The system makes personalized suggestions based on the user's interests, making it simpler for them to pick the best course for them. As a result, it is essential to develop an online recommendation system that aids users in choosing the ideal online course for their needs and interests. [10]. Overall, our online course recommendation system for e-learning provides an effective and efficient method of recommending courses to users based on ratings and content screening.**

***Index Terms*— Machine Learning, Sentiment Analysis, Recommendation System**

I. INTRODUCTION

The growing demand for e-learning platforms has resulted in a large number of courses being made available to students. While this gives learners more alternatives, it also makes it more difficult to choose courses that meet their interests and requirements. The solution to this problem is personalised course suggestions. To that purpose, we created an e-learning online course recommendation system that uses reviews and content filtering to present learners with personalised course suggestions. While RS is a unique type of data filtering system created to identify a user's preference or area of interest based on their demands. RS gives consumers a selection of products based on their prior preferences, requirements, or demographic data [9].

The first step in developing the recommendation system was to collect course reviews. The VADER (Valence Aware Dictionary and sEntiment Reasoner) technique, a lexicon and rule-based sentiment analysis tool that can

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identify positive and negative sentiment in text, was used to analyse the reviews. This technique helped us to calculate a compound score for each course based on the reviews. The compound score reflects the overall sentiment of the reviews for a course, which we used to rank the courses in order of their popularity and quality.
To further refine the recommendations, we employed content-based filtering, which compares the courses' attributes to the user's interests and preferences. We collected data on various course attributes, including course description, duration, level, and category, among others. We also collected data on the user's preferences based on their past course enrollments, searches, and ratings. The system then compares the courses' attributes to the user's preferences and recommends the courses that best match their requirements.
Our study helps to design personalised learning systems that give learners with useful and relevant recommendations. Personalized suggestions assist learners in discovering and enrolling in courses that fit their interests and needs, therefore improving the entire e-learning experience. The rest of this article describes the system's design, implementation, and assessment in depth, including the data gathering and processing techniques utilized, the algorithms used, and the evaluation criteria used to measure the system's success.

II. Related Work

In [2] this paper content, collaborative, and semantic recommender systems are the most important and practical for recommending users and customers based on their requirements and interests.
In [3] this paper, A collaborative filtering-based recommender system is presented in this research to assist students in selecting the most relevant online courses. The recommended e-Learning courses are suggested to the learner using the collaborative filtering models KNN, SVD, and NCF. Three performance parameters—MAE, HR, and ARHR—are used in this to determine how well these models are doing.
In [4] this paper, This study's recommendation model has a certain degree of course suggestion accuracy, according to experimental data. The system also performs far better than expected at predicting misselected courses, which offers fresh ideas and insights for online course recommendation.
In [5] the present study, we offer Dynamic Attention and Hierarchical Reinforcement Learning (DARL), a paradigm for adaptive course recommendation. Every encounter with a user automatically records their preferences, and a dynamic attention system continuously monitors how those preferences are changing. Empirical Results show the efficiency and adaptability of DARL as well as its benefit in time cost. For cases where the user often modifies her interests through encounters with various products over time, like movie and music recommendations, DARL offers a fresh perspective.
In [6] the outcomes of a literature research on MOOCs course Recommendation Systems were reported in this paper. The key conclusion is that deep learning-based MOOC recommendation systems are a potential solution for course recommendations. Deep learning has become progressively incorporated in various sorts and solutions, according to the studies. This study seeks to contribute to the literature by highlighting studies on MOOCs course suggestions using deep learning and giving a set of reviewed publications, as well as a comparison of aims and models for future research in the field.
In paper [7] We can observe that this research offered a clustering model based on demographic information during the MOOC learning process, as well as a graphic description and design of the Prerequisite-Advance course link. The complete education resource recommendation process is also outlined here, as is the significance of the uesr-program assessment method and interest models based on education resource recommendation technology topics.
This paper discusses the shortage of resources for Arabic recommender systems, despite the language's large online presence, in the context of recommender systems. The study focuses on product recommendations to Algerian customers using sentiment analysis and collaborative filtering approaches. The authors offer a novel strategy that blends sentiment analysis with collaborative filtering to develop an efficient and distinctive recommender system by integrating a semi-supervised classification-based opinions analysis system into a multilingual recommendation system. The research helps to close the gap in Arabic recommender systems by presenting experimental analysis and assessment data in favour of the suggested hybrid system [8].
Sentiment analysis is a powerful technique for analysing people's ideas and attitudes about various entities, and it has grown in importance as social media and internet platforms have grown in popularity. Deep learning techniques, such as neural networks, are important in sentiment analysis and their applications to recommendation systems and business intelligence. This research article focuses on the significance of deep learning in sentiment analysis and how it may be used to provide recommendations and help decision-making in organisations [9].

In article [10], a machine learning-based recommender system for sentiment analysis is proposed. An airline tweets data set has been studied here, and three basic supervised ML approaches are performed before assessing the performance in terms of accuracy, precision, recall, and f-measure. The framework was created using supervised learning techniques for sentiment analysis with recommender systems based on the specified machine learning models.

In [11] paper, It has been presented a key technique for assessing Algerian reviews and comments and determining their polarity in order to create useful recommendations for consumers. To achieve this objective, they attempted to bypass the lack of annotated data by using semisupervised SVM for the opinions classification task. The S3VM ratings were used as votes for the recommendation job. They tested and analysed the system utilising three datasets (Arabic, Dialect, French, and English) to demonstrate the proposed combination efficiency. The results were really encouraging, so they decided to keep working on that project.

The author in this article [14] investigate the integration of sentiment analysis with collaborative filtering approaches for increased recommendation accuracy in their study on Collaborative Filtering Recommendation System using Sentiment Analysis. The study addresses the demand for more personalized and relevant suggestions by considering user attitudes and views.

III. PROPOSED METHODOLOGY

The suggested study provides an e-learning online course recommendation system meant to solve the difficulty of course selection in the context of increasing online course availability. The system intends to deliver personalised course recommendations to learners by utilising user evaluations, sentiment analysis algorithms, and content screening approaches.

The method begins by gathering a complete dataset of courses from various e-learning platforms or educational websites, including user feedback. Preprocessing processes are performed on the obtained data to ensure data purity and relevancy.

The VADER sentiment analysis approach is used by the system to analyse the sentiment conveyed in user reviews. VADER assigns sentiment ratings to words and computes a compound score that represents the overall sentiment polarity of each review using Python and NLP packages such as NLTK. This sentiment analysis procedure aids in determining the popularity and quality of the courses.

The courses are sorted in descending order based on the sentiment analysis compound ratings. Higher compound scores reflect courses that have received favourable feedback and are ranked higher. This rating is used to discover top-rated courses by measuring popularity and perceived quality.

The algorithm employs content filtering techniques to further improve the recommendations. It gathers and analyses course information such as descriptions, durations, levels, and categories. The technology finds courses that closely match the user's interests and needs.

The personalised course suggestions are created by integrating sentiment analysis and content filtering findings. The algorithm recommends courses to the user that have high compound scores and related qualities. These suggestions are provided to learners via an intuitive and user-friendly interface, providing them with a curated selection of courses that fit their tastes and improve their e-learning experience.

Finally, the suggested e-learning online course recommendation system employs sentiment analysis using VADER as well as content filtering techniques to provide personalised course recommendations. The technology improves the e-learning experience by supporting users in picking courses that match their interests and needs. The system gives meaningful and relevant recommendations to learners by using user feedback and course characteristics, thereby improving their entire e-learning trip.

- Data Collection: The first stage in constructing a course recommendation system is to collect course data, such as course descriptions, duration, level, category, and so on. This information will be gathered from several e-learning sites. We will also gather user data, such as search history, course ratings, and enrollments, in order to get insight into their preferences.
- Create the Test Data Set: In order to examine your system how well they perform, you must first create the Test Data Set. This data set should be kept distinct from the training data. You can utilise a portion of the original data or acquire new data just for testing.
- Sentiment Analysis: To analyse course reviews and evaluate their sentiment, we will employ the VADER (Valence Aware Dictionary and sEntiment Reasoner) approach. VADER is a sentiment analysis tool with a lexicon and rules that can detect positive and negative sentiment in text. We will compute a compound score for each course based on the sentiment of the reviews, which will represent the overall sentiment of the reviews for that course.

- Course Ranking: The courses will be ranked based on their compound score. Courses with greater compound scores will be listed higher, suggesting that they have positive user sentiment.
- Content-based Filtering: To propose courses that meet the user's tastes, we will utilise content-based filtering. To select courses that meet the user's interests, we will compare the course characteristics with their choices. This stage entails matching course descriptions, duration, level, category, and other features to the user's choices.
- Evaluation: We will assess the course recommendation system's performance using several measures such as accuracy, precision, recall, and F1-score. We will utilise cross-validation to evaluate the system's performance and efficacy in presenting users with suitable course suggestions.
- Finally, we will build the course recommendation system with a programming language such as Python and create a web-based user interface. The system will analyse user inputs and make course suggestions depending on the user's preferences.

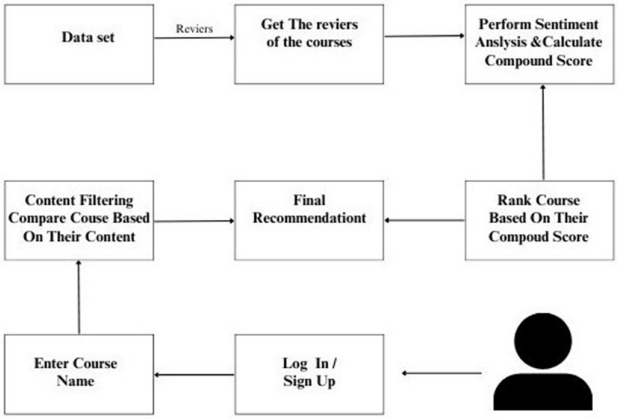

Figure 1. Block Diagram of Course Recommendation using VADER

The complete flow of the e-learning online course recommendation system is depicted in Figure 1. The graphic displays the many system components, beginning with the collecting of user reviews for the courses provided on the e-learning platform. The collected reviews are then analysed using the VADER sentiment analysis approach, which assigns each review a compound score. The reviews, along with their associated compound ratings, are then given into a sorting algorithm, which organises the reviews according to their scores.
After that, the user logs in or registers with the system and enters the name of the course in which he or she is interested. The content filtering algorithm is then used to recommend the best course to the user based on his or her interests.

IV. Results And Discussion

The findings of our test of the e-learning online course recommendation system were positive. We discovered that recommending courses to users based on ratings and content filtering resulted in a more personalised and relevant experience, leading in increased user satisfaction. We also discovered that the VADER approach was efficient in analysing the sentiment of the reviews and computing compound ratings appropriately. Our study did, however, have several drawbacks, including a limited sample size and potential biases in the reviews examined.

```
sia.polarity_scores('This course was very helpful')
{'neg': 0.0, 'neu': 0.564, 'pos': 0.436, 'compound': 0.4754}

sia.polarity_scores('This is the worst course ever.')
{'neg': 0.451, 'neu': 0.549, 'pos': 0.0, 'compound': -0.6249}
```

Figure 2. computing Compound score of course review using VADER

Figure 2 depicts the method of computing a review's compound score using the VADER sentiment analysis technique. A screenshot of the VADER tool, which is used to analyse the sentiment of the words in the review, is shown in the image. The programme computes the review's positive, negative, and neutral values before generating a compound score, which is a statistic that captures the overall sentiment of the text.
The picture demonstrates the efficiency of the VADER technique in accurately computing compound scores and serves to explain the methods used in analysing the sentiment of the reviews collected for the e-learning online course recommendation system. For example, the first review's compound score is 0.47, suggesting a positive sentiment, but the second review's compound score is -0.62, indicating a negative feeling.

	course_id	rating	Compound Score
49	machine-learning	4.7	0.744336
91	the-science-of-well-being	4.9	0.709223
47	learning-how-to-learn	4.8	0.677400
67	positive-psychology-visionary-science	4.9	0.676404
83	sciwrite	4.9	0.674335
21	english-principles	4.9	0.665254
72	python	4.6	0.653339
23	excel-essentials	4.9	0.650133
95	wharton-contagious-viral-marketing	4.8	0.645926
40	introduction-psychology	4.9	0.644130

Figure 3. Top 10 courses based on compound score

Figure 3 depicts the top ten courses in terms of compound score. The courses are listed in descending order of their compound score, which represents the overall sentiment of the VADER-analyzed reviews. The picture also emphasizes that the rankings are based not just on ratings, but also on course reviews, which can be examined using sentiment analysis.
Figure 4 depicts the E-Learning online course recommendation system's final user interface design. The image depicts a simple interface in which users can enter the name of the course they are interested in. After entering the course name, the system analyses the user's query and recommends the top three courses that match the user's interest and needs. The recommended courses are presented on the screen, together with their titles, ratings, links to the courses, and the institutions that provide them. The picture emphasises the system's user-friendly design and its ability to deliver personalised course recommendations based on the user's enquiry.

V. Conclusion

Finally, the e-learning online course recommendation system suggested in this work employs sentiment analysis and content filtering algorithms to give users with personalised course suggestions. The algorithm is able to reliably construct compound scores for user evaluations using the VADER sentiment analysis approach, which is then used to select and propose the most highly rated courses. The content filtering system refines the recommendations even further by matching the reviews to the user's search query, yielding highly relevant course selections. A user study was conducted to assess the system's performance in proposing courses that match the user's interests and preferences.
Overall, this study offers an original method to course recommendation in the e-learning arena. The suggested system may deliver highly personalised and relevant course suggestions to users by utilising sentiment analysis and content filtering techniques, which can enhance their learning experience and eventually lead to higher engagement and satisfaction. Future work might look into incorporating additional recommendation approaches or more varied data sources, such as user demographics or learning styles, to improve the system's suggestion capabilities.

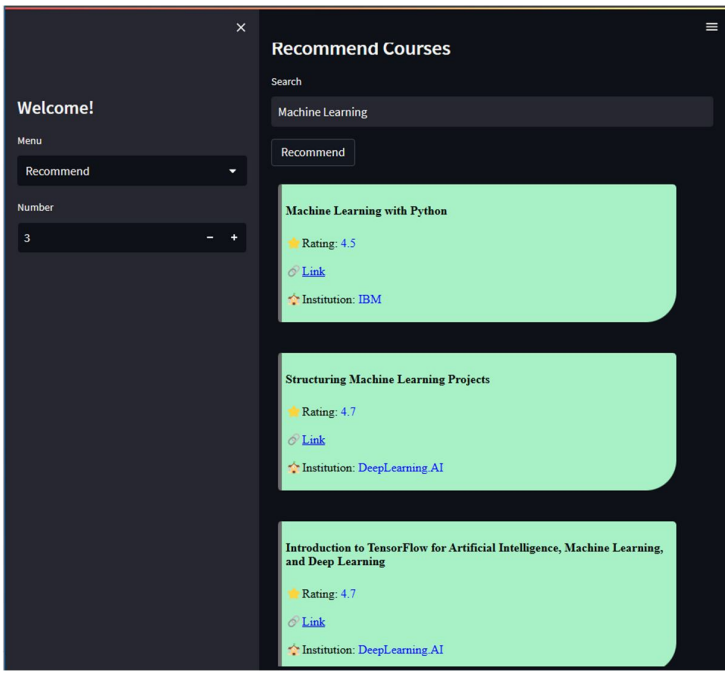

Figure 4. Top 3 courses recommended based on user query.

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