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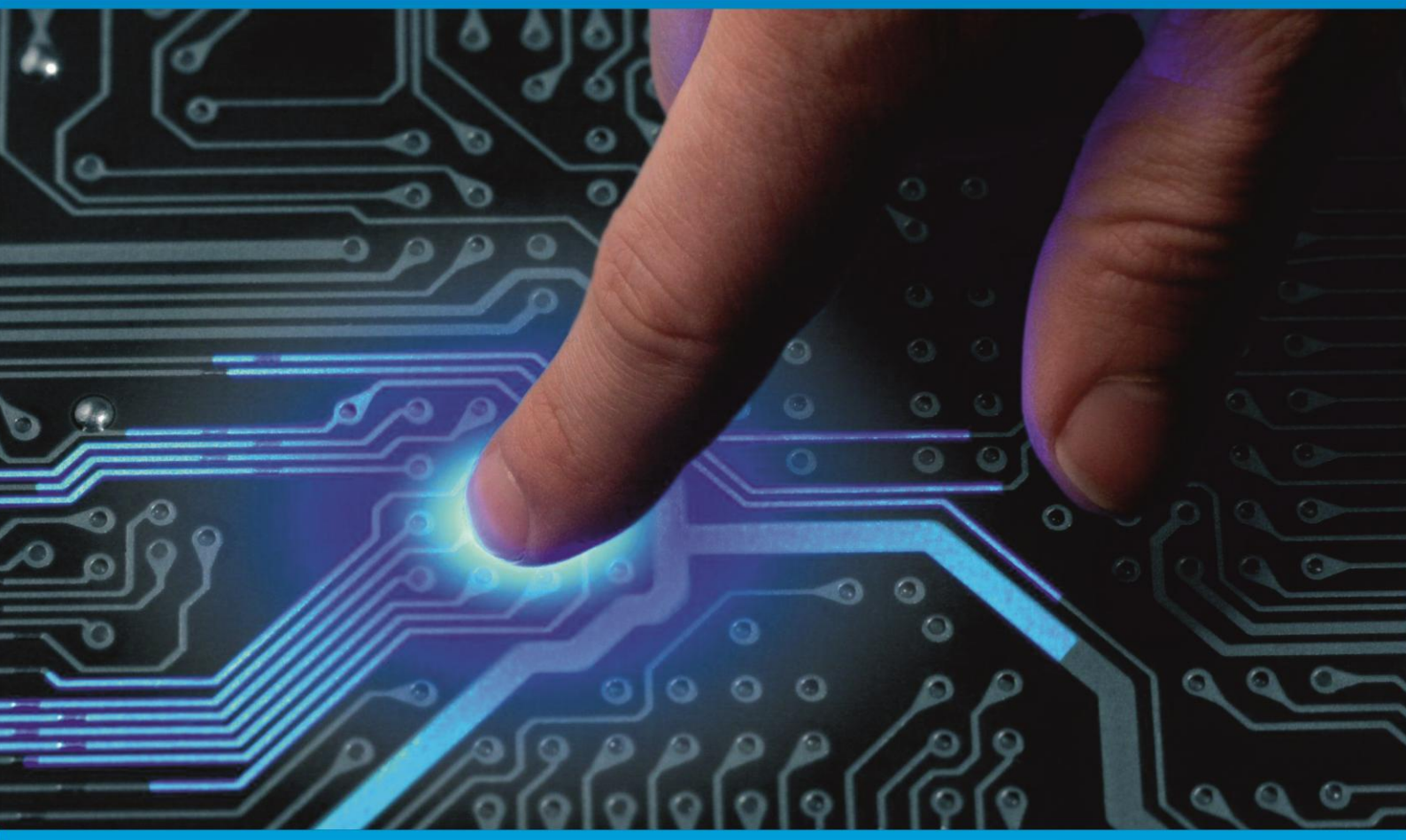

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Learning Resource Recommendation System

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ABSTRACT: Traditional e-Learning environments are based on static contents considers all learners are similar, so they are not able to satisfy every learner's need. New education system should appear to ensure the personalization of learning contents. This work aims to develop a new personalization environment to students that provide the best learning materials according to their preferences, interests, background knowledge, and their memory capacity to store information. A new recommendation approach based on content-based filtering is presented. This approach is an integrated learning environment to deliver personalized learning material. Resource management systems (RMS) are typically used by large educational institutions and focus on supporting instructors in managing and administrating online courses. However, such RMS typically use a "one size fits all" approach without considering each and every learner's profile. A learner's profile consists of his/her learning styles, goals, prior knowledge, abilities, and interests. However, considering learners' profile helps in enhancing the learning experiences and performance of the learners within the course. The proposed system supports learners by providing them recommendations about which learning resource within the course, considering their learning ability, most to least rated books, based on past orders, most popular and often visited books to make them learn easily. This kind of personalization can help in improving the overall quality of the learner by providing recommendations of learning resources that are useful for learners. Such recommendations can increase learner performance during the Course.

KEYWORDS: Resource Management System(RMS),Content-based filtering,Traditional e-Learning

I. INTRODUCTION

The login page has been set up to get the information of the students. Once the students create his/her login then they will be allowed to the home page where there have to choose their respective semester to get a recommended book. After selecting their respective semester, depending upon their CGPA(Cumulative Grade Points Average) ,selected subject and the ability of the student a book will be recommended. The content based filtering algorithm plays a vital role in recommending the book for the users. It also recommends similar and books having high rating for the users to look into. Personalized services learn users' interests and behaviour by collecting and analyzing user information, and mine the hidden interests and behaviour rules of user , so as to formulate corresponding information filtering strategies and provide personalized recommendation services . As one of the most important technologies in personalized service, content based filtering recommendation is the most successful technology currently applied. E-learning can be supported through different forms like web-based learning, computer-based learning, or virtual classrooms and content delivery via e-networks, audio or video tape ,CD-ROM, e-mails, wireless and mobile technology . E-learning offers various benefits like increased accessibility to information, better content delivery, personalized instruction, content standardization, accountability, availability, self-pacing, interactivity, confidence, and increased convenience. Due to the benefits mentioned above, many educational institutions focuses on e-learning. To organize the learning content in e-learning, resource management systems are typically used. Resource management system can be defined as an infrastructure that delivers and manages instructional content, identifies and assesses individual and organizational learning and training goals, tracks the progress towards meeting those goals, and collects and present data for supervising the learning process of an organization. Typically, the courses in RMS consists of learning objects (LOs). Generally, RMSs deliver the same kind of course structure and LOs to each learner. Personalization in LMS refers to the functionality which enables the system to uniquely address a learner's needs and characteristics such as levels of expertise, prior knowledge, skills, interests, preferences and learning styles to improve a learner's satisfaction and performance the course. As the World Wide Web is expanding in an exponential rate, the size and the complexity of

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the information are increasing along with it. The Web now contains a massive amount of information, most of it does not interest the user, either as unwanted information (advertisements, spam etc.) or as content irrelevant to his interests. However, every user has unique interest, which might correlate with a small percentage of the Web's content. Therefore, it has become difficult and time consuming for the users to find information that they are interested it. To help users to find the information that is in accordance with their interests the Web can be personalized, using recommender systems.

As world wide web is expanding in an exponential rate the size and complexity of the information is increasing along with it. The web now contains the massive amount of information, most of it does not interest the user, either as unwanted information or content irrelevant to the users interest.

However every user has a unique interest, which might correlate with a small percentage of the web's content. Therefore, it has become even more difficult and time consuming to search the information they needed. To help the users find the information that in accordance with the interests the web can be recommended using the content based filtering algorithm.

II. RELATED WORK

Recommender systems support individual user in making decisions from vast available choices by recommending the appropriate choice(s) based on behaviour or opinions of a group with the similar characteristic /behaviour. Recently recommender systems have been applied in the e-learning domain. This section describes such works in two directions: First, research works focusing on providing recommendations based on the activities done by learners in the course mainly find the associations to find the activities done by the learners and then provide recommendations to individual learner. In this recommendations are based on learners activities in a course rather than learner characteristics,needs and profiles. Second, we describe research works in which recommendations were provided to learners based on other similar learners having similar characteristics/attributes and CGPA obtained. For example, Zaiane[8] built a recommender agent that provides recommendations of learning activities within a course based on learner's history. Khribi et al[9]developed a recommender system based on the learners recent web histories, and similarities and dissimilarities among the contents of the learning materials. Markellou et al[10]Proposed a framework for personalized e-learning. The personalization is done based on the domain and the association among the usage profiles. We use "apriori algorithm" to find association rules. The recommended learning resources were determined based on the domain ontology. Furthermore, Liu and Shih [11]used association rule mining as basis for their material recommendation system. The system analyzes the logs to look into learner's learning behaviour and to identify the associations between the learning course content. The system used the behaviour of previous learners to recommend the learning content. The first group of research works mainly considers the web usage data of the learners in between the course. These works focus on grouping similar learners based on their interest ,activities in a course. Our work is different from the above-cited works as we are recommending the learning resources based on their learning ability using the content based filtering algorithm.

The second group of research works finds similar learners based on the characteristics and then recommendations are provided based on the information collected. For example, Tang and McCalla[12] proposed an evolving web-based learning system that finds the relevant content from the web for all the learners. They use a clustering technique to calculate learners similarities for resource recommendation.Self organizing maps are used to categorize learners based on similar interests into one group. Then a data mining technique is used to draw the rules of the best learning path for each group of learners. Kerkiri et al proposed a framework based on reputation metadata in a recommender system. The reputation metadata is the ratings of the learning resources provided by the learners. The system uses learning object metadata and the learners profile based on PAPI. The registered learners were requested to provide information about themselves to create a profile including qualifications , skills, licenses, etc. The similarity between the learners is calculated using the Pearson's learning ability .After collecting all the information about learners and learning resources(metadata and reputation metadata), content - based filtering was applied to recommend personalized learning resources. The recommendations of learning materials is based on the learners CGPA. Their experiment shows that such recommendations help in increasing learner's satisfaction level. Yang et al proposed a personalized recommendation algorithm for curriculum resources based on semantic web technology using domain ontology. The algorithm gathers the curriculum resources of interest based on user evaluation and user browsing behavior.Therefore, similarity among users can be calculated from similarity between core concepts. The users were asked to provide ratings for every learning resource. The similarity among learners is computed based on their ratings given for the resources.Then the interest degree of users is calculated for each interest category of the nearest neighbours, and finally recommendations were provided based on the value obtained. Ghauth and Abdullah developed an e-learning content based recommendation system. The system is based on vector space model and learners rating. The system considers

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the rating of learners those who had studied learning material and got marks higher than 80 %. Mojtaba and Isa proposed a recommender system to suggest e-learning material resources to students. They model the learning material in multidimensional space of material's attributes like authors' name, subject, price,ratings. The learners were modeled in such a way that the learning material attributes can be considered using rating. To consider learning material attributes in learner profiles, ratings given by the learners were used. The recommendations were generated based on content-based method. The research works mentioned in the second group provide recommendations based on other similar learners and resources. However, these works mainly used the learner interest and ratings as the parameter for generating groups. In our work we recommend resources based on their learning ability and if they required they can also get resources recommended based on the rating. Furthermore, our work is different as it considers learners ability based on their CGPA's, including their learning styles, expertise level, skills and prior knowledge, along with their performance in the course.

III. PROPOSED ALGORITHM

A. *Design Considerations:*

- Login page is created for each and every student
- Student has to enter their details to login inside the page
- Inside the login page,the student should select their respective semesters.
- After selecting the semester and clicking submit,student can access their resources.

B. *Description of the Proposed Algorithm:*

The system we proposed will consider the user's knowledge level for example here we will use the CGPA of the students and recommend them the learning resources that are classified into two different levels namely, easy and medium levels Two databases were created for this system. One is for storing the user's information from which the data will be retrieved for validation during login process and the other one is for storing the learning resource's information from which the data will be retrieved for validation during login process and the other one is for storing the learning resource's information from which the data will be retrieved for recommendation engine. In this system, the recommendation engine will work based on the concept of Content Based Filtering Algorithm.
The Algorithm of the Content-Based Filtering is as follows:

```
# the minimum number of votes required to appear in recommendation
list, i.e, 60th percentile among 'num_rating'
m= df1['num_rating'].quantile(0.6)
# items that qualify the criteria of minimum num of votes
q_items = df1.copy().loc[df1['num_rating'] >= m]

# Calculation of weighted rating based on the IMDB formula
def weighted_rating(x, m=m, C=C):
v = x['num_rating']
R = x['avg_rating']
return (v/(v+m) * R) + (m/(m+v) * C)

# Applying weighted_rating to qualified items
q_items['score'] = q_items.apply(weighted_rating, axis=1)

# Import CountVectorizer and create the count matrix
from sklearn.feature_extraction.text import CountVectorizer
count = CountVectorizer(stop_words='english')

# Compute the Cosine Similarity matrix based on the count_matrix
from sklearn.metrics.pairwise import cosine_similarity
cosine_sim = cosine_similarity(count_matrix, count_matrix)

# Get the pairwsie similarity scores of all resources
sim_scores = list(enumerate(cosine_sim[idx]))
# Sort the resources based on the similarity scores
```

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```
    sim_scores = sorted(sim_scores, key=lambda x : x[1], reverse=True)
# Get the scores of the 10 most similar resources
    sim_scores = sim_scores[0:3]

# return food_indices for accomplishing personalized recommendation using Count Vectorizer
    def personalised_recomms(orders, df1, user_id, columns, comment="based on your past orders"):
    order_indices  = get_latest_user_orders(user_id, orders)
    book_ids = []
    BOOK_ID = []
    recomm_indices = []
```

Evaluation Process:

The Difficulty level of a student is classified based on the CGPA obtained by that Student . The students are classified into two levels : MEDIUM and EASY.

- MEDIUM - (8,9,10) CGPA
- EASY – (5,6,7) CGPA

IV. PSEUDO CODE

Step 1: Create a dataset for students and give that in the code.
Step 2: Calculate the minimum number of votes required to appear in recommendation.
Step 3: Display the items that qualify the criteria of minimum number of votes
Step 4: Calculate the weighted rating based on the IMDB formula.
Step 5: Apply the weighted rating to qualify items.
Step 6: Import Count Vectorizer and create the count matrix.
Step 7: Compute the Cosine similarity matrix based on count vector and get pairwise similarity scores for all resources.
Step 8: End.

V. SIMULATION RESULTS

The recommendation algorithm in python programming language is implemented using Google Colaboratory (colab.research.google.com/).

The login page is created using HTML , CSS , JavaScript and PHP. The front end(web page) and the back end(recommendation algorithm-python) is joined to get the desired output. Front end and back end is joined using the shell_exec command. At last it is executed using the Xampp Server.

Content-based filtering algorithm is used for recommendation algorithm. We use this algorithm to filter the resources based on the user's preference and recommend them the same.The resources are recommended based on the past orders,top rated books and most popular books.

The login page has been set up to get the information of the students. Once the students create his/her login then they will be allowed to the home page where there have to choose their respective semester to get a book recommended. After selecting their respective semester, depending upon their CGPA (Cummulative Grade Points Average), selected subject and the ability of the student a book will be recommended. The content-based filtering algorithm plays a vital role in recommending the book for the users. It also recommends similar and books having high rating for the users to look into.

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GRAPHICAL ANALYSIS

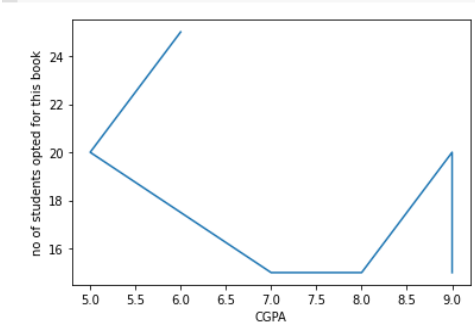

Fig 1:CGPA and no of students opted the book

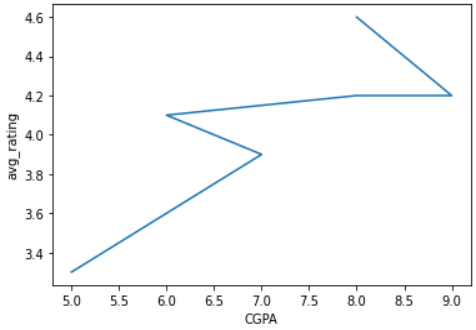

Fig 2:CGPA and avg_rating

DISPLAY OF RESOURCES

	resource_id	YEAR	SEMESTER	SUBJECT	RESOURCE	DIFFICULTY LEVEL	avg_rating	num_rating	no of students opted this book
38	39	II	4	PROBABILITY AND QUEUEING THEORY	https://onlinelibrary.wiley.com/doi/book/10.1002/9781118625651	MEDIUM	3.9	10	25
39	40	II	4	PROBABILITY AND QUEUEING THEORY	https://www.researchgate.net/publication/267439176_Fundamentals_of_applied_probability_and_random_processes_2nd_ed	EASY	3.9	10	20
40	41	II	4	COMPUTER ARCHITECTURE	https://ict.iitk.ac.in/wp-content/uploads/CS422-Computer-Architecture-ComputerOrganizationAndDesign5thEdition2014.pdf	MEDIUM	3.8	15	15
41	42	II	4	COMPUTER ARCHITECTURE	https://www.academia.edu/15060586/Computeranization_And_Embedded_Systems_Hamacher_Vranesic_Zaky_Manjikian_6Ed_Mgh_2012	EASY	3.8	15	10
42	43	II	4	DATABASE MANAGEMENT SYSTEM	https://www.db-book.com/db6/	MEDIUM	4.0	20	5
43	44	II	4	DATABASE MANAGEMENT SYSTEM	https://seu1.org/files/level6/IT344/Fundamentals_of_Database_Systems,_6th_Edition.pdf	EASY	4.0	20	15
44	45	II	4	DESIGN AND ANALYSIS OF ALGORITHMS	https://doc.lagout.org/science/0_Computer%20Science/2_Algorithms/Introduction%20to%20the%20Design%20and%20Analysis%20of%20Algorithms%20%283rd%20ed.%29%20%5BLevitin%202011-10-09%5D.pdf	MEDIUM	4.6	30	20
45	46	II	4	DESIGN AND ANALYSIS OF ALGORITHMS	https://thebookee.net/engineering-pdf-dl141254	EASY	4.6	30	10
46	47	II	4	OPERATING SYSTEMS	http://www.cs.put.poznan.pl/akobusinska/downloads/Operating_Systems_Concepts.pdf	MEDIUM	4.2	28	20
47	48	II	4	OPERATING SYSTEMS	https://dokumen.pub/operating-systems-a-spiral-approach-0072449810-9780072449815.html	EASY	4.2	28	15
48	49	II	4	SOFTWARE ENGINEERING	http://sendy.itmaranatha.org/PSI/RPL-7th_ed_software_engineering_a_practitioners_approach_by_roger_s_pressman_.pdf	MEDIUM	3.9	10	15
49	50	II	4	SOFTWARE ENGINEERING	http://index-of.co.uk/Engineering/Software%20Engineering%20(9th%20Edition).pdf	EASY	3.8	15	20

	resource_id	YEAR	SEMESTER	SUBJECT	RESOURCE	DIFFICULTY LEVEL	avg_rating	num_rating	no of students opted this book
50	51	II	3	DISCRETE MATHEMATICS	https://notendur.hi.is/mhh6/html/_downloads/Discrete%20Mathematics%20and%20Its%20Applications%20-%20Kenneth%20Rosen%20(2012).pdf	MEDIUM	3.0	10	20
51	52	II	3	DISCRETE MATHEMATICS	https://books.google.co.in/books/about/Discrete_Mathematical_Structures_with_Ap.html?id=d4JQAAAAMAAJ&redir_esc=y	EASY	2.5	5	15
52	53	II	3	DIGITAL PRINCIPLES AND SYSTEM DESIGN	https://www.allabout-engineering.com/digital-design-with-an-introduction-to-the-verilog-hdl-vhdl-and-system-verilog/	MEDIUM	4.6	30	15
53	54	II	3	DIGITAL PRINCIPLES AND SYSTEM DESIGN	https://www.semanticscholar.org/paper/Digital-Principles-and-Design-Givone/b1c48790df700f1e0ebdf537162d142e20bd1bec	EASY	4.2	28	20
54	55	II	3	DATA STRUCTURES	http://161.246.4.119/download.php?DOWNLOAD_ID=3858&database=subject_download	MEDIUM	3.9	10	25
55	56	II	3	DATA STRUCTURES	https://www.engbookspdf.com/download/Cpp/Data-Structures-Using-C-Second-Edition	EASY	3.9	10	20
56	57	II	3	OBJECT ORIENTED PROGRAMMING	https://srikarthiks.files.wordpress.com/2016/07/java-the-complete-reference-8th-edition.pdf	MEDIUM	3.8	15	15
57	58	II	3	OBJECT ORIENTED PROGRAMMING	https://github.com/AMKhalifa/books/blob/master/programming%20books/Java/Core%20Java%20Volume%20I-%20Fundamentals%209th%20Edition-%20Horstmann%2C%20Cay%20S.%20_%20Cornell%2C%20Gary.pdf	EASY	3.8	15	10
58	59	II	3	COMMUNICATION ENGINEERING	https://crvildatas.com/download/principles-of-communication-systems-by-herbert-taub	MEDIUM	5.0	21	6
59	60	II	3	COMMUNICATION ENGINEERING	https://ict.iitk.ac.in/wp-content/uploads/EE320A-Principles-Of-Communication-CommunicationSystems-4ed-Haykin.pdf	EASY	5.0	21	23

Fig 3 and 4: display of resources for each semester based on the student category

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VI. CONCLUSION AND FUTURE WORK

Based on the fact that group recommendation covers the characteristics of multiple learners, there is almost no difference in the sequence of learning resources recommendation, which is not in line with the actual situation of personalized learning needs. The personalized characteristics of a single learner are added, to form a two-way self-balanced state, and evolve to the personalized recommendation stage. A personalized learning resources recommendation method based on content - based filtering is proposed to solve the problems of slow recommendation speed and low matching degree. The simulation results show that the proposed recommendation method can effectively match the sequence of personalized learning resources, and verify the feasibility and efficiency of the algorithm. How to accurately plan the personalized characteristics between learners and learning resources is the key to recommendation. With the rapid growth of resources and data, more intelligent technologies need to be used for reference and improved in the future to better meet the personalized learning needs. This paper introduces the PRS which integrates a recommender system approach into learning management systems. PRS provide recommendations on which learning objects within a course are more useful for learners, considering the learning object he/she is visiting as well as the learning objects visited by other learners with similar profiles. The recommendation mechanism uses association rule mining to find the association between learning resources. The main contributions of the work are: first, to find ability of learners using their CGPA and also the system allows to search similar books based on rating.

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