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A Review on Course Recommendation System in Higher Education using Machine Learning

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Abstract:

In recent years, the availability of online learning platforms has grown exponentially, offering students an extensive range of courses to choose from. However, this abundance of options often poses a challenge for students in deciding which courses are the most suitable for meeting their educational goals and interests. Course recommendation systems aims to address this issue by leveraging data-driven techniques to provide personalized course recommendations. This study focuses on various machine learning algorithms which are used for designing course recommendation systems. Course Recommendation system is an personalized tool to assisting students for selecting most suitable courses based on their interest, individual preferences and career goal. Course recommendation systems have emerged as valuable tools to assist students in making informed decisions by leveraging data-driven techniques.

Keywords: Content Based Method, Machine Learning, National Education Policy, Recommendation system, Supervised Learning

I. Introduction:

In today's dynamic educational system, students are facing numerous options when it comes to selecting courses with their academic goals, interests, and career opportunities. However, making well-informed decisions about selecting courses can be challenging due to the lot of available courses. The main primary goal of students in education is to secure well paid positions. The assessment of student's achievement has involved into a vital responsibility for educators throughout the academic year. To address this issue, course recommendation systems have emerged as valuable tools to assist students in navigating their academic journey effectively. A Recommender System also known as recommendation system is specialized type of information filtering system designed

to anticipate the rating or preference that a user might assign to a specific item. Typically, a recommender system assesses a user's profile by considering certain reference traits and aims to forecast the 'rating' or 'preference' that a user might assign to an item they haven't previously explored [1].

In India, traditional education system is used for teaching and learning process. This traditional system focuses on the relationship between students and teachers. This system is student and teacher centric education system which emphasizes on moral and ethical values. The education system in India is very diverse and complex. This system has mixture of traditional and modern approaches. Here the teacher has complete authority over the activities which are taken in the classroom. Due to this students are independent of taking their decision.

The primary objective of a course recommendation system is to offer individualized advice by utilizing diverse methodologies like Data mining, Machine learning and Artificial Intelligence. These systems analyze a multitude of factors, including students' academic performance, previous course selections, interests, and the overall curriculum structure of educational institutions. The recommendation system is used for decision making.

Now a day a recommendation system is used in large number of applications such as e-learning, web, tourism, movies, music and e-commerce. Hence it is important to build a high quality recommendation system to provide a personalized recommendation to users [2].

II. Choice based Credit System in Senior College:

The University Grants Commission (UGC) was established as a statutory body under the Government of India. Its role involves coordinating, setting and upholding standards for teaching, examinations and research in realm of University education. UGC provides guidance and recommendations about courses for graduate and under graduate students [3]. The primary emphasis of the University Grant Commission (UGC) is to define and uphold benchmarks for teaching, examinations and research within university education.

Currently, in Indian higher education system, the University Grant Commission (UGC) has recommended the implementation of Choice Based Credit System (CBCS) that incorporates a standardized grading system across the educational framework. A choice based credit system is a structured method for delineating an educational program by assigning credits to its individual components. The total allotted credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours. The CBCS provides a mechanism allowing students to select subjects according to their preferences, interests and comprehensive abilities [4]. Any degree course offers many subjects namely core, elective and add on. The core subjects are compulsory and from elective and add on subjects, students can select any

subjects for their degree completion. Each subject is assessed according to allocated credit for performance evaluation of students.

Following are the some basic features of CBCS-

1. The educational structure adheres to a semester based pattern. Each academic year is divided into two semesters.
2. In CBCS pattern, each course is allocated a particular number of credits corresponding to its academic workload.
3. CBCS emphasizes continuous assessment through assignments, quizzes, projects, presentations, and class participation.
4. It divides courses into core and elective courses from which core course is mandatory which provides fundamental knowledge about subjects while elective course allow student to explore specialized topics within their field of study.
5. It includes skill enhancement courses which focus on practical skills, soft skills, and employability skills.

III. Problems in CBCS:

CBCS is an academic framework which is designed to provide students with flexibility for choosing a course. However, some limitations are faced by students regarding practical implementation. In many current systems student's pre determine their subjects at the program's commencement often with guidance of a mentor [3]. CBCS has major challenge that is the lack of uniformity across universities and colleges. Different institutions may implement CBCS differently, which leads to confusion for students who transfer or seek admission to different colleges. An additional concern within CBCS is the excessive emphasis on grades and credit hours, promoting an education approach centered around grades rather than prioritizing comprehensive learning and skill enhancement. Yet another challenge involves student decision-making and guidance, where students may encounter difficulties in making well-informed choices regarding their subjects. This can result in a misalignment between their interests and the chosen courses.

IV. National Education Policy 2020:

The National Education Policy (NEP) 2020 constitutes a holistic reform endeavor with the objective of overhauling the education system in India. It serves as the document that articulates the vision and roadmap and advancement of the education system in India. NEP 2020 introduces flexible approach for students to choose a combination of subjects in the form of major and minor as per the student interest and their career goal. In NEP 2020, higher education institutions will promote multidisciplinary education and flexible curriculum structure which offers multiply entries and exit points to create new possibilities for lifelong learning. The National Education Policy (NEP)

underscores a transition from the conventional teacher centric instructional model to a more student oriented approach to learning and teaching [9].

NEP 2020 introduces multi-disciplinary education policy which will help to students to learn and grow holistically for equipped with stronger knowledge base. NEP 2020 introduces Academic Bank credit (ABC) to store the academic credits of the student [10]. The National Education Policy (NEP) of 2020 places significant emphasis on the implementation of a multidisciplinary education system. This system empowers students to selectively opt for subjects or courses aligned with their individual preferences and aptitude [11].

V. Literature Review:

S. Prabha and K. Duraisamy[1] examined different algorithms and methods employed in constructing recommender systems. Each of these approaches comes with its own strengths and weaknesses: user-based approaches tend to be accurate but lack scalability, item-based approaches are scalable but may sacrifice precision compared to user-based methods. Hybrid recommender systems, which integrate features from both user-based and item-based algorithms, aim to strike a balance between accuracy and scalability. Research in recommender systems primarily centers around enhancing the algorithm's performance, scalability, and accuracy.

Deepjyoti Roy, Mala Dutta [2] conducted a thorough examination and assessment of research papers pertaining to recommender systems, with a specific focus on varied applications published from 2011 to 2021. Their review compiled extensive information, including the application domains, employed techniques, simulation tools, targeted applications, performance metrics, datasets, system features, and challenges associated with various recommender systems. Additionally, the study presented research gaps and challenges, paving the way for future exploration and perspectives in recommender system research.

Nikita Sawarkar, Dr M M Raghuwanshi, Dr. K. R. Singh [3] are focused on developing a recommendation system to forecast the future career trajectories of undergraduate students. The system relies on analyzing the elective choices made by students throughout their academic program to determine their prospective career paths.

Dr. P. S. Aithal, P. M. Suresh Kumar [4] highlighted that the UGC consistently takes steps to enhance efficiency and excellence in India's Higher Education System. The primary goal is to enhance academic quality comprehensively, encompassing curriculum design, the teaching-learning process, and examination and evaluation systems. Nevertheless, various universities throughout the country employ diverse approaches in conducting examinations, evaluations, and grading systems.

Mfowabo Maphosa, Wesley Doorsamy, Babu Paul[5] unveiled that numerous recommender system methodologies and data mining algorithms are employed to accomplish the goal of suggesting

elective courses. Significantly, the study proposed emerging trends in the field that recommender systems should explore to enhance their efficacy. These trends encompass integrating acceptance models to boost recommendation acceptance and evaluating the effectiveness of user feedback.

Dr.D.V. Divakara Rao, Dr.P.M. Manohar, A. Venkatesh[6] introduced a hybrid course recommendation system that integrates both collaborative filtering and content-based filtering to enhance the quality of course recommendations. By considering the behaviors and preferences of similar users, the system can provide more precise recommendations based on the course content. This approach is expected to elevate student engagement, satisfaction, and retention. The growing trend toward personalizing the learning experience underscores the rising significance of developing and implementing effective course recommendation systems in the future of education.

Neha, Anurag Sharma, Rajvir Kaur[7], explore expert systems for course recommendations that leverage machine learning techniques to examine student data, identifying correlations among the courses chosen by students. By tapping into the experiences of graduates, insightful findings can be gleaned, enabling recommender systems to suggest the most fitting courses for new students. Recognizing and respecting students' aspirations in career choices is crucial, especially considering that not all students have access to adequate counseling and career guidance. This lack of support can pose challenges for them in identifying a career path that fosters personal development.

Dr Himanshu Maniar [8], delves into the basics of machine learning and its potential application in predicting students' performance. Recent machine learning-based methodologies have been explored in the discussion. Additionally, the analysis of students' performance requirements has been categorized into four groups. Each activity within these groups can potentially be addressed by employing suitable machine learning techniques.

VI. Resolving Problems of CBCS:

The Course recommendation system plays an important role with respect to students regarding choosing the right course for their carrier path. The main purpose of course recommendation system is to recommend a product as per their interest based on their profile. A recommendation system contains three major elements i.e., a user, an item and rating [5]. Recommendation system is used to find appropriate course to students. With the help of recommendation system students can receive a personalized and relevant learning experiences.

The course recommendation system will give some suggestion for selection of right course for students as per their interest. It predicts about selection of course for students based on past learning of the data. The effectiveness of the system depends on its ability to accurately recommend courses that align with the student's interests and need [6]. Depending on the choice and prediction of courses, course recommendation system recommends a good career path for students. In the field

of educational guidance a recommendation system plays a crucial role in helping students to select course that match their personal interest and preferences. By supplying students with details about available courses and offering customized recommendations derived from their interest, academic history and other pertinent factors, course recommendation system plays a crucial role in helping to overcome the challenges that individuals encounter[7].

VII. Machine Learning Algorithms:

Machine learning, within the realm of artificial intelligence (AI), concentrates on creating algorithms and diverse models to empower computers in learning and making predictions or decisions autonomously, without requiring explicit programming. Machine learning involves a collection of methods that enable computers to acquire knowledge in a manner similar to human learning processes. Machine learning is focused on building computer system that learns from data. Machine learning is a branch of computer science encompasses a variety of methods employed to examine available data, discover concealed structure and comprehend patterns [8]. We can develop course recommendation system for student with the help of any programming language and machine learning algorithm.

Following diagram broadly shows types of Machine learning algorithms.

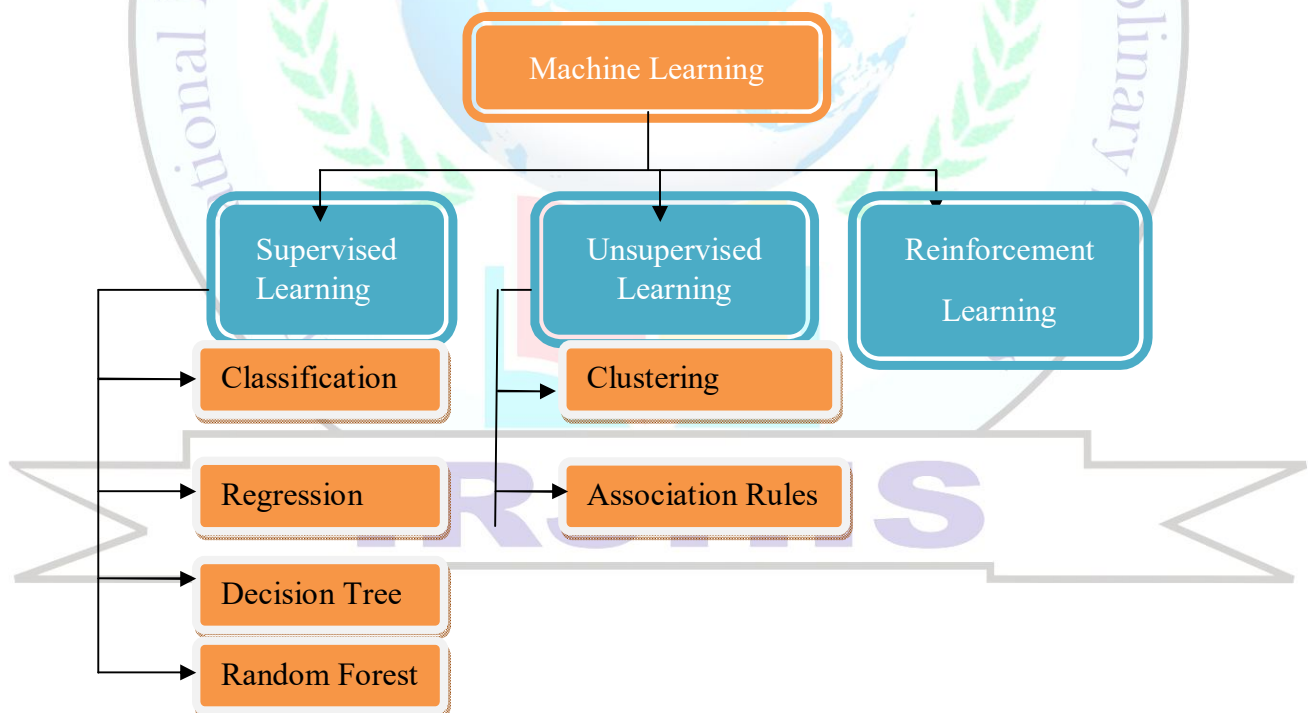


Fig 1: Types of Machine Learning Algorithms

A. Supervised Learning:

In supervised learning we use labeled dataset to train the model or algorithms. In this type data needs to be labeled accurately. In supervised learning algorithm, machine needs an external

supervisor to learn. Following the training and processing the phases, the model undergoes testing by being exposed to sample test data to assess its ability to accurately predict the output. These algorithms are utilized for predictive tasks, either to classify data into distinct categories or to predict numerical values, commonly known as classification or regression, respectively [8]. The supervised learning algorithm has objective, is to determine a mapping function that correlates the output variable to the input variable. In simpler terms, it seeks to identify the relationship between input and output variables.

This type of algorithm includes regression and classification problem. Supervised learning includes linear regression, KNN, decision trees, Bayesian Linear Regression, Random Forest, Support vector Machines and Naïve Bayes. Supervised learning primary benefit lies in the model capability to forecast output based on past experiences or prior knowledge.

B. Unsupervised Learning:

Unsupervised learning is a machine learning technique in which models are not supervised using training dataset. Instead of it, model itself finds hidden pattern. Unsupervised learning is the training of a machine using information that is neither classified nor labeled. In unsupervised learning no teacher is provided that means no training will be given to the machine. It mainly deals with the unlabelled data.

Unsupervised learning algorithm contains problems like clustering and association. Unsupervised learning is favored because obtaining unlabeled data is more straightforward compared to acquiring labeled data. In other words, unsupervised learning is advantageous when working with data that lacks predefined classifications or annotations. For developing a course recommendation system using we can use Clustering. Clustering is employed to categorize the essential student data for classification purposes. The actions conducted are organized into meaningful groups based on historical data [12].

C. Reinforcement Learning:

Reinforcement is a learning method which is focuses on how agents can learn to make sequences of decisions in an environment in order to maximize a cumulative reward. It involves making appropriate decisions to optimize the reward in a given situation. Reinforcement learning is a form of machine learning in which an intelligent agent engages with its environment, gaining the ability to make informed decisions through iterative interactions. Reinforcement learning uses different types of algorithms that learn from outcomes and decide about which action to take next. In Reinforcement Learning, an agent learns autonomously through feedback mechanisms without the need for labeled data. In this, the model can correct the errors that occurred during the training process. Reinforcement learning includes Q-Learning, Deep Adversarial Networks and Temporal

Difference (TD) algorithms.

VIII. Proposed Work:

The proposed system aims at building add on course recommendation system for students to choosing an add on subjects as per their interest. With the help of recommendation system the career path of students will define after choosing the right subject or course as per their interest and knowledge. The most crucial path of career of student is the selection of right course. The Proposed system focuses on to use collaborative filtering technique to recommend best appropriate course to students.

Conclusion:

Course recommendation system helps to students in choosing the course process. For recommending course to student similarity is performed. The subject of focus is to develop add on course recommendation system for students which will help to students for decision making about choosing the right course as per their interest and knowledge about the subjects. This study also reviews the machine learning algorithm which is used for developing course recommendation system for students. We have explored the basics of machine learning and its application in predicting student performance.

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