

Development of personalized Recommendation System for E-Learning Platform

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Abstract - In later a long time, e-learning stages such as Coursera, Udemy, edX, and Khan Institute have revolutionized the way individuals procure information and abilities over the globe. With the computerized change of instruction, learners nowadays have get to to an overpowering number of courses, instructional exercises, and learning assets. Be that as it may, exploring this tremendous ocean of substance to discover personalized, important, and skill-appropriate materials remains a major challenge for clients. This inquire about proposes a energetic substance suggestion framework custom fitted particularly for elearning situations, planned to convey personalized learning encounters based on client interface, learning designs, ability levels, and interaction history. The center objective of this framework is to direct learners along effective learning ways by prescribing substance such as courses, instructional exercises, video addresses, and perusing materials. These proposals are not as it were based on what clients have locked in with already, but moreover consider how well they have performed, their favored modes of learning (video, content, intelligently works out), and their career or learning objectives. By analyzing behavioral information and execution measurements, the framework points to improve learning productivity and inspiration through focused on suggestions.

Key Words: Machine Learning, Mobile Application Development, Data Collection, Model Optimization, Agricultural Technology, AI Integration, Future Challenges.

1. INTRODUCTION

The fast development of online instruction has definitely changed how people learn, upskill, and move over careers. E-learning platforms such as Coursera, Udemy, edX, and the Khan Institute have become central to this advancement, offering a wide range of courses across disciplines, open and often at a low cost. Be that as it may, with the gigantic deluge of instructional substance, learners are regularly overpowered with choices, making it troublesome to recognize the foremost significant, skill-appropriate, and personalized learning materials..

1.1 Related Work

Recommendation frameworks have been a conspicuous zone of investigate in both scholastic **and** commercial spaces, playing a basic part in personalization for stages such as Netflix, Amazon, and Spotify. Within the setting of instruction, a few e-learning stages have coordinated recommender frameworks to upgrade client engagement and learning results. This segment presents a survey of existing strategies, advances, and restrictions recommendation systems.

1.2 Personalized Learning Path Generation

Rather than giving isolated recommendations, the system builds a progressive learning path. This is achieved by:

- Mapping prerequisites and dependencies between courses
- Identifying learner's skill gaps using test results and skipped topics
- Sequencing content from beginner to advanced levels within a topic

2. DEPLOYMENT PLAN & FLOW DIAGRAM

The arrangement of the proposed content recommendation system follows a modular microservice architecture to ensure scalability, performance, and effectiveness. The framework is composed of key components including a frontend interface, backend APIs, the recommendation engine, databases, and machine learning model management. The frontend is built using React.js or Vue.js and deployed as a static web application, typically served through NGINX or platforms like AWS S3 with CloudFront for efficient content delivery and fast loading times. This interface interacts directly with the backend to fetch course recommendations, display user dashboards, and manage feedback submissions.

3. CONCLUSIONS

The proposed content recommendation system presents a dynamic and adaptive solution to the growing demand for personalized learning experiences in e-learning environments. By integrating content-based filtering, collaborative filtering, clustering techniques, and Natural

Language Processing, the system delivers intelligent course suggestions tailored to each learner's history, preferences, and goals. Through structured learning paths, users are guided from foundational concepts to advanced topics in a coherent, measurable progression. The hybrid approach not only improves recommendation accuracy but also supports learners in overcoming knowledge gaps, maintaining motivation, and achieving educational outcomes more efficiently. The evaluation of the system demonstrated promising results across various metrics such as precision, recall, NDCG, and user engagement. Simulated tests indicated a significant increase in course completion rates and learner satisfaction among users who received personalized recommendations. The use of feedback loops and skill mapping contributed to continuous model refinement and context-aware suggestions, making the system responsive to evolving learner behaviors and interests. Despite its strengths, the current system was evaluated in a controlled environment with synthetic data. For broader validation, real-world deployment and A/B testing on platforms like Coursera, Udemy, or a university LMS would be essential. Additionally, long-term learner tracking would allow better understanding of content retention and career outcomes. Looking forward, future enhancements may include the integration of reinforcement learning to optimize long-term learning to trajectories, voice-based interaction for accessibility, multilingual support to cater global learners, and cross-platform synchronization. Furthermore, help incorporating psychological models of learning and motivation could make the system even more human-centric. As e-learning continues to expand, intelligent recommendation systems like this will play a vital role in shaping the future of education by making it more personalized, inclusive, and effective.

VIII. LIMITATIONS

Despite the strong architecture and performance of the proposed content recommendation system for elearning platforms, several limitations exist that must be acknowledged. First, the evaluation of the system was conducted primarily on a synthetic dataset and controlled environment, which may not fully capture the diversity, unpredictability, and behavioral complexity of real-world learners. As such, actual performance metrics might differ once deployed at scale in a live learning management system (LMS). Additionally, the system currently focuses on textual and structured data inputs such as course descriptions, quiz scores, and ratings, which may overlook other valuable data like forum interactions, project submissions, and time-series patterns of study behavior. Another limitation lies in the "cold start" problem, which persists despite hybrid methods—new users and newly added courses still suffer from insufficient data, making early recommendations less reliable. While clustering and collaborative techniques mitigate this issue, the system requires further enhancements like knowledge graphs or interactive onboarding to make stronger early predictions. Furthermore, the recommendation engine, while personalized, may overfit to a learner's past behavior and

limit exposure to crossdomain or exploratory learning unless explicitly tuned to encourage diversity. From a computational standpoint, continuous model updates, feedback incorporation, and real time recommendation generation demand significant processing resources and efficient data pipelines, especially with a growing user base. If not managed properly, latency and scalability could hinder the user experience. Lastly, the system's explainability is limited; while effective, it doesn't yet offer transparent reasoning for why specific courses are recommended, which could be important in building user trust and engagement in academic settings.

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