Online Personalized Learning Remediation/Tutoring Tool: A Teacher Recommendation System

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Abstract. Online education will be paired by developing intelligent systems that can provide personalization to the learner. To that extent ,this paper is proposing the design for an Online Personalized Learning Remediation/Tutoring Tool to help learners find the most suitable teachers for certain topics. The tool relies on a dataset of teacher profiles, comprising the subjects taught, video links, ratings, and experience, so that using machine learning techniques, it could recommend top educators. Applying feature extraction using CountVectorizer and recommendation based on cosine similarity, it will ensure the robust and personalized search experience to the learners. The tool will augment the process of learning by not wasting time of the learner searching for an appropriate teacher and provides an uninterrupted user experience through an easy-to-understand web interface. This system increases the satisfaction of learners along with optimizing their ability to engage with the relevant teachers effectively.

Keywords. Personalized learning, Teacher recommendation system, Cosine similarity, Online tutoring, Educational technology.

1 INTRODUCTION

The rapid advance in educational technology allows for more personal and efficient learning. Nonetheless, connecting students with the most suitable teachers who can understand their specific learning needs continues to be a great challenge within online education. This study bridges the gap by proposing an online personalized learning remediation and tutoring tool that recommends teachers to the students according to the interested topic of their choice.

With the increased demand for customized education and considering the large numbers of materials accessible through the Internet, a well-designed system that can match students with proper instructors is badly needed. Existing platforms do not sufficiently possess matching algorithms in their design, resulting in suboptimal learning experiences and inefficient use of educational resources.

This study contributes to the body of knowledge in educational technology by Designing a Teacher Recommendation System using Cosine Similarity. Incorporating multiple factors such as subject expertise, teacher ratings, and experience into the recommendation algorithm.

Creating an intuitive interface for students to find suitable teachers whom they would want to connect with. This study evidences the potential data-driven approach has in reshaping personalized learning experiences. Using machine learning and data analysis, the real potential of this research would be to take online tutoring to its best possible effectiveness and value.

2 RESEARCH METHODOLOGY

2.1 Dataset

A dataset is the basis on which the personalized learning remediation/tutoring tool was designed. The sample dataset contains different attributes describing the teachers. The important information contained in each of the teacher's profiles includes:

Teacher Name: The full name of the instructor.

Topics Taught: A list of topics or competencies that the educator is skilled in such as Python, Java or HTML. This information will enable matching the appropriate educator with learner query.

Video Links: A URL for online teaching material, such as video lectures, would be hosted on websites such as YouTube or other education-based websites. The system would link these links so that students can view the teacher's content conveniently.

Teacher Ratings: A numeric rating, typically on a 5-point scale, reflecting the feedback and satisfaction levels of previous students. This helps prioritize teachers who have demonstrated high teaching effectiveness.

Years of Experience Number of years the teacher has been teaching actively or actively working in the subject. This attribute would be useful to filter or rank teachers, especially when learners have a preference for experience.

Biographical Details: A short description of the educator's expertise, including any unique teaching approaches or professional achievements. It is used to further set a context for a system supporting recommendations. We will create a dataset for five teachers and populate the same with this information for an initial implementation; however, the model is scalable, and we can add larger datasets to make more accurate recommendations.

2.2 Feature Extraction

Feature extraction is the transformation of raw data to a suitable format for usage by the machine learning algorithms. In the case of our system, we have used CountVectorizer, a text processing tool from the domain of NLP, for doing so.

Now CountVectorizer will transform each entry in column "Subjects, "which contain all the subjects each teacher teaches into a numerical matrix. This matrix is sometimes called a bag-of-words representation and counts frequency occurrences for each distinct word, or term in this case, in the dataset.

Teacher	Python	Java	HTML	CSS	JavaScript	SQL	PHP
Alice Johnson	1	1	1	0	0	0	0
Bob Smith	0	0	1	1	1	0	0
Charlie Brown	1	0	0	0	0	1	0

For example, if a teacher has "Python, Java" in her subject list, then the CountVectorizer is going to transform such terms into a vector where every unique term will translate into a feature-meaning a column-and a 1 indicates the teacher teaches that subject, while a 0 indicates she doesn't. With this bag-of-words method, we can now make numerical comparisons between teacher profiles. For instance, we may compare using similarities calculated from the vectors of a query like "Python" and those subjects in the dataset after converting them into vectors.

2.3 Similarity Computation

After feature extraction, we use cosine similarity to compute how closely the teacher’s expertise aligns with the learner’s query. Cosine similarity is particularly well-suited for this task because it measures the cosine of the angle between two vectors (representing the teacher's subject list and the learner's query vector).

Cosine Similarity Formula:

$$\text{Cosine similarity} = A.B / ||A|| \, ||B||$$

Where:

- A represents the vector of the subject list for a teacher.
- B represents the vector of the learner's query (e.g., "Python").
- The numerator A·B is the dot product of the two vectors.
- The denominator $\| A \| \, \| B \|$ is the product of the magnitudes of the two vectors.

The cosine similarity score will range from -1 to 1:

- **1** indicates perfect similarity (i.e., the query and the teacher's subjects match exactly).
- **0** indicates no similarity (the teacher does not teach the subject in the query).
- **-1** indicates opposite subject content (though in our context, scores will be between 0 and 1 since we're dealing with positive data).

For example, if a student searches for "Python," the cosine similarity between the search query and each teacher's subject vector will be calculated. A teacher with "Python" in their subject list will have a high similarity score, while those who do not teach Python will have a lower or zero score.

2.4 Recommendation Algorithm

A procedure to recommend teachers about a topic is designed. The algorithm performs the following operations:

It identifies the available teachers, who teach the requested topic, making use of string matching techniques.

It calculates the similarities of the identified teachers with all other teachers in the dataset using a pre-computed similarity matrix.

It orders the sorted list of teachers by scores in decreasing order.

Outputs the three most similar teachers with their full profiles.

The algorithm presents a good balance between the exact matches of topics and total similarity of subjects, thus generating diverse, relevant recommendations.

3 THEORY AND CALCULATION

3.1 Cosine Similarity

Cosine similarity measures the cosine of the angle between two vectors, which in our case represents the subject matter expertise of different teachers. The formula for cosine similarity is given by:

$$\text{Cosine similarity} = A.B / ||A|| \, ||B||$$

4 RESULTS AND DISCUSSION

4.1 Results

The implementation of the online personalized learning remediation/tutoring tool yielded several significant results:

Effective Teacher Matching: The system successfully matches students' topic requests with relevant teachers. For example, when a student searches for "Java", the system not only identifies teachers who explicitly teach Java but also recommends teachers with related skills such as other programming languages or web development.

Comprehensive Teacher Profiles: The recommendation system provides a holistic view of each teacher, including:

- Name and subjects taught
- Video link for a sample lesson
- Rating out of 5 stars
- Years of experience
- A brief biography highlighting their expertise

User-Friendly Interface: The HTML-based output presents recommendations in an attractive, card-based layout. This design makes it easy for students to quickly compare different teachers and make informed decisions.

Scalability: While the current implementation uses a small dataset, the underlying algorithm and structure are scalable to much larger teacher databases.

Personalization: By considering multiple factors (subjects, ratings, experience) in the recommendation process, the system offers a personalized experience tailored to each student's needs.

4.2 Discussion points

Relevance of Recommendations: The cosine similarity approach proves effective in identifying teachers with relevant expertise. However, future iterations could explore more sophisticated algorithms that weigh different factors (e.g., rating, experience) according to student preferences.

Impact on Learning Experience: By streamlining the process of finding suitable teachers, this system has the potential to significantly enhance the online learning experience. Students can quickly connect with experts in their areas of interest, potentially leading to more effective and engaging tutoring sessions.

Limitations: The current system relies heavily on the accuracy and completeness of teacher profiles. Incomplete or outdated information could lead to suboptimal recommendations. Additionally, the system does not yet account for student feedback or learning outcomes, which could further refine recommendations over time.

Future Enhancements: Potential improvements include:

- Incorporating student feedback and learning outcomes into the recommendation algorithm
- Implementing real-time availability of teachers

- Expanding the range of subjects and specializations
- Integrating with existing online learning platforms for seamless user experience

In conclusion, the results demonstrate the viability and potential impact of using data-driven approaches to personalize the online learning experience. The system effectively bridges the gap between students seeking knowledge and teachers offering expertise, paving the way for more efficient and tailored educational experiences.

5 CONCLUSION AND FUTURE WORK

The online personalized learning remediation/tutoring tool developed here is the advancement of the educational technology field. That, by using data analysis and machine learning techniques-in particular, cosine similarity-the system will be able to match students with suitable teachers based on a specific topic request.

Some conclusions that can be inferred from this study include the following:

Cosine similarity might actually be useful in matching the best teachers with relevant topics and providing students with personalized suggestions.

This would be such a system that helps ensure proper decisions based on sound tutoring choices by including profiles that list subjects taught and ratings or experience with biographical information.

Thus, these systems may encourage ease in terms of identifying suitable tutors in order to reduce hassle in the process of online learning.

The approach scales well and can be pointed towards a more expansive database with broader varieties of topics.

Although the above implementation looks promising, there is further scope in its development. Future work could be put upon dynamic factors like real-time availability of a teacher, feedback from students, and learning outcomes for fine-tuning the recommendation algorithms.

This research is a contribution toward greater personalization of education and access to such knowledge on the part of experts for learners. As online education advances, it will be their toolbox to make sure students are quite easily connected with the best teacher to suit their needs in learning.

In addition to the classic tutoring scenario, it's accessible to professional development that is skills-based learning and even peer-to-peer knowledge-sharing platforms. By iteratively refining and expanding such systems, we can work toward more efficient, effective, and personalized educational ecosystems that reward both learners and educators.

6 Declarations

6.1 Limitations of the Study

The primary limitations of this study include:

The use of a small, simulated dataset which may not fully represent the diversity of real-world teaching profiles.

The lack of real-time testing with actual students and teachers to validate the effectiveness of the recommendations.

The focus on text-based subject matching, which may not capture all aspects of teaching quality or student-teacher compatibility.

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6.3 Funding Source

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6.4 Competing Interests

The authors declare no competing interests. This work was purely carried out as an academic exercise mandated by the mini project work.

6.5 Human and Animal Related Study

1. *Ethical Approval*

As it is a scholarly mini-project involved in the designing of some technological solution, this mini-project involves no experimentation on human subjects or animals. Therefore, there are no applicabilities for ethical clearances.

2. *Informed Consent*

Our project did not have any human subjects beyond normal scholastic engagements that occur within our university. Any testing or feedback was conducted on an informal basis among peers and faculty members within the academic environment of Anurag University.

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