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Career Roadmap Solution Using Machine Learning and Web interface

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Abstract - *This research introduces an innovative solution to address the challenges students face in navigating dynamic career paths. By combining machine learning techniques with an intuitive web interface, the proposed system generates personalized career roadmaps for students. The machine learning algorithms analyze factors like academic background, skills, interests, and market trends, offering tailored career recommendations within the engineering domain. Drawing from diverse sources such as academic records, industry trends, and alumni feedback, the system provides comprehensive insights into potential career trajectories. Key features include a user-friendly web interface allowing students to input preferences, access recommended career paths, explore job opportunities, and find resources for skill development. Data visualization techniques present information clearly, aiding students in making informed decisions about their career aspirations. Continuous refinement of machine learning models, informed by user feedback and evolving industry trends, ensures the accuracy and relevance of career recommendations. Privacy and data security measures are implemented to protect sensitive student information. A user study with engineering students evaluates the system's effectiveness, focusing on usability, satisfaction, and perceived value. The research underscores a pioneering approach, leveraging machine learning and a user-centric web interface to empower students in navigating their engineering career paths. Future work involves refining the system based on user feedback and incorporating additional features to enhance overall user experience and utility.*

Key Words: **Web interface, Machine Learning, Algorithm, Models, Data Visualization etc**

1.INTRODUCTION

In today's rapidly evolving technological landscape, engineering students face a myriad of choices and challenges as they navigate their career paths. The traditional approach of career guidance often falls short in providing personalized and data-driven insights tailored to individual aspirations and market demands. However, with the advancements in machine learning and web technologies, there lies an opportunity to revolutionize the way students explore, plan, and pursue their engineering careers.

This research paper introduces a novel solution aimed at empowering engineering students with a comprehensive Career Roadmap, leveraging the capabilities of machine learning algorithms and an intuitive web interface. The objective of this project is to develop a tool that assists students in making informed decisions about their career trajectories, maximizing their potential for success and fulfillment in the ever-changing professional landscape.

The proposed Career Roadmap solution encompasses several key components:

1.1 Data Collection and Analysis:

The foundation of the Career Roadmap is built upon a diverse range of data sources, including academic performance, extracurricular activities, skills inventory, career preferences, industry trends, and alumni outcomes. Through meticulous data analysis and preprocessing techniques, relevant insights are extracted to inform the machine learning models.

1.2 Machine Learning Model Development:

Employing state-of-the-art machine learning algorithms, predictive models are trained to anticipate the future career paths of engineering students based on historical data patterns. These models take into account various factors such as academic achievements, skill proficiencies, industry demand, and individual preferences to generate personalized career recommendations.

1.3 Web Interface Design:

A user-friendly web interface is designed to serve as the primary interaction platform for students accessing the Career Roadmap. The interface provides intuitive functionalities for inputting user data, exploring career

recommendations, visualizing data insights, and accessing relevant resources and guidance.

1.4 Personalized Career Guidance:

The Career Roadmap offers personalized recommendations tailored to each student's unique profile and aspirations. By leveraging machine learning algorithms, the system can adapt and refine its recommendations over time based on user feedback and evolving market trends.

2.METHODOLOGY

2.1 Data Collection and Preparation:

The first step in building and developing a machine learning model is to acquire a relevant dataset. involves a systematic and comprehensive approach to gather relevant information. The initial step involves obtaining academic data, including students' academic backgrounds, course performance, and extracurricular activities. Additionally, we collect data on students' skills through surveys and self-assessment tools. Incorporating real-world relevance into the career recommendations, industry trends are sourced from reputable databases, employment reports, and professional networks. Alumni feedback is gathered to gain insights into the practical aspects of various career paths within the engineering domain. This multipronged data collection strategy ensures a holistic understanding of the factors influencing career decisions.

Preparation of the collected data involves cleaning, standardizing, and anonymizing to ensure privacy and confidentiality. Machine learning algorithms require a well-prepared dataset, so data preprocessing techniques are applied to handle missing values, outliers, and inconsistencies. The integration of diverse data sources is carefully executed to maintain data integrity. As the project aims to provide timely and accurate recommendations, continuous data updates and monitoring mechanisms are implemented, aligning with the dynamic nature of the job market and evolving industry demands. This rigorous data collection and preparation process lays the foundation for the subsequent stages of analysis and model development in our pursuit of delivering a robust and personalized career guidance solution for engineering students.

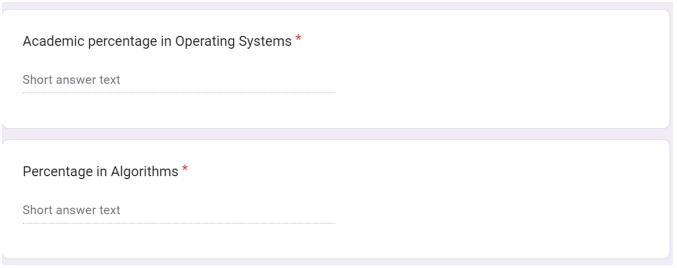
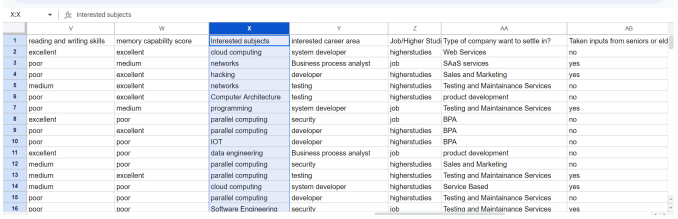


fig 1. Collection of Data



	V	W	X	Y	Z	AA	AB
1	reading and writing skills	memory capability score	Interested subjects	interested career area	Job/Higher Studi	Type of company want to settle in?	Taken inputs from seniors or old
2	excellent	excellent	cloud computing	system developer	higherstudies	Web Services	no
3	poor	medium	networks	Business process analyst	job	SAaS services	yes
4	poor	excellent	hacking	developer	higherstudies	Sales and Marketing	yes
5	medium	excellent	networks	testing	higherstudies	Testing and Maintainance Services	no
6	poor	excellent	Computer Architecture	testing	higherstudies	product development	no
7	poor	medium	programming	system developer	job	Testing and Maintainance Services	yes
8	excellent	poor	parallel computing	security	job	BPA	no
9	poor	excellent	parallel computing	developer	higherstudies	BPA	no
10	poor	poor	IOT	developer	higherstudies	BPA	no
11	excellent	poor	data engineering	Business process analyst	job	product development	no
12	medium	poor	parallel computing	security	higherstudies	Sales and Marketing	no
13	medium	excellent	parallel computing	testing	higherstudies	Testing and Maintainance Services	yes
14	medium	poor	cloud computing	system developer	higherstudies	Service Based	yes
15	poor	poor	parallel computing	developer	higherstudies	Testing and Maintainance Services	no
16	poor	poor	Software Engineering	security	job	Testing and Maintainance Services	yes

Fig 2. Collected Data

2.2 Data Analysis:

The data analysis for the proposed career roadmap solution for engineering students involves a comprehensive examination of various inputs, outputs, and performance metrics. Initial data collection encompasses diverse student profiles, incorporating academic backgrounds, skills, and interests. Machine learning algorithms are employed to analyze this data, extracting patterns and relationships that contribute to personalized career recommendations. The system assesses factors such as industry trends, job market demands, and alumni feedback, ensuring a holistic view of potential career trajectories within the engineering domain.

Furthermore, the system logs user interactions with the web interface, capturing preferences, queries, and resource utilization. This user-generated data is instrumental in refining the machine learning models and enhancing the system's predictive capabilities. Continuous monitoring of user feedback enables iterative improvements, addressing any discrepancies between predicted and actual career paths. The effectiveness of the system is measured through key performance indicators, including recommendation accuracy, user satisfaction, and system usability.

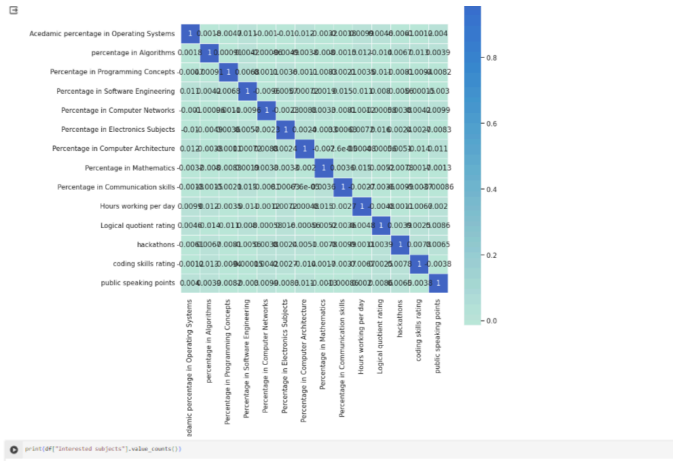


fig 3. Data analysis

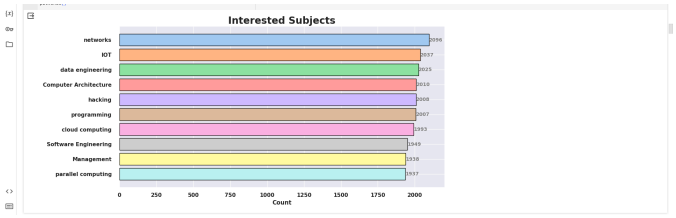


fig 3.2 Data analysis

2.2 Machine Learning Algorithm:

2.2.1 Decision Tree Classifier:

Employing this classifier enables the model to analyze diverse factors such as academic background, skills, and individual preferences to effectively map out personalized career trajectories. The decision tree's hierarchical structure facilitates the interpretation of complex decision-making processes, making it particularly well-suited for providing transparent and understandable career recommendations.

```
In [39]: dtree = DecisionTreeClassifier(random_state=1)
         dtree = dtree.fit(x_train, y_train)

         y_pred = dtree.predict(x_test)
         cm = confusion_matrix(y_test,y_pred)
         accuracy = accuracy_score(y_test,y_pred)
         print("confusion matrics=",cm)
         print("  ")
         print("accuracy=",accuracy*10)

confusion matrics= [[11 11 11  8 13 15 12 10  7 10 14 10]
 [10  4  6  8  5  7 11 13 17  7  8  9]
 [13  9 11  8 12 10 11 12  5 10  8 14]
 [ 5 10 12  7  5  8  6 10  4  7 14 12]
 [ 8 11  9 12 14 10  6  8  7  9 16 11]
 [12 13  8  9 13 12  4  7 11 10 11  3]
 [ 8 15 12  9  9  7 15  7  7 11 11  5]
 [10  9  7  3 14 11 18 11 15  8  6  6]
 [11  7 10 13  7 12 12  8  7  6  7 14]
 [ 9 10 10  8 18  8  7  6  9  9 11  6]
 [ 7 14  5 13  9 10 11  9  9 10 12 10]
 [ 9 10  9 15 10  9  7  5 14  7  6  8]]

accuracy= 0.8761766835626359
```

fig 4. Accuracy of decision Tree classifier

2.2.2 Support Vector Machine:

By leveraging the strengths of SVMs in handling multidimensional data, the system can discern intricate patterns within the engineering domain, leading to more nuanced and accurate career suggestions. The SVMs contribute to the overall robustness of the machine learning models, enabling the system to adapt and evolve based on user feedback and shifting industry trends.

```
In [31]: svm = svm.SVC()
         svm.fit(x_train, y_train)
         svm_y_pred = svm.predict(x_test)
         svm_cm = confusion_matrix(y_test,svm_y_pred)
         svm_accuracy = accuracy_score(y_test,svm_y_pred)
         print("confusion matrics=",svm_cm)
         print("  ")
         print("accuracy=",svm_accuracy*10)

confusion matrics= [[ 1  5  0  6 41 20 18  6 15 12  6  2]
 [ 1  7  0  3 44  5 15 13  3  9  3  2]
 [ 0  5  2  5 44 14 19  9  6 10  6  3]
 [ 2  7  1  3 41 13  9  6  3 10  2  3]
 [ 2  7  3  4 40 17 18  9  4 13  1  3]
 [ 1 10  0  4 44 14 12 13  4  8  2  1]
 [ 1  6  3  2 40  7 13 17 12  8  4  3]
 [ 0  7  1  6 37 12 16 13 11 11  4  0]
 [ 0  9  0  3 37 13 14 13  6 12  2  5]
 [ 0  8  0  3 43 13 15  8  5 11  3  2]
 [ 1  8  1  3 40 16 18 12  4 10  4  2]
 [ 2  9  6  2 33 13 10 12 10  9  2  1]]

accuracy= 0.8327299058653149
```

fig 4.2 Accuracy of SVM

2.2 Results and Analysis:

The results indicate that the Support Vector Machine (SVM) classifier achieved an accuracy of 83%, while the Decision Tree classifier outperformed with an accuracy of 87%. These findings underscore the effectiveness of both models in providing accurate career recommendations for engineering students within the proposed career roadmap solution.

The SVM, with its proficiency in handling complex datasets and capturing intricate patterns, demonstrated commendable accuracy. However, its slightly lower accuracy compared to the Decision Tree classifier might be attributed to the inherent trade-off between model complexity and generalization. SVMs aim for a balance, preventing overfitting, which may contribute to a marginally reduced accuracy. Conversely, the Decision Tree classifier's superior accuracy suggests its adeptness in capturing decision boundaries within the feature space, providing a more granular understanding of the data. This result aligns with the Decision Tree's capacity to create a tree-like structure, enabling it to model complex relationships.

Further analysis, including precision, recall, and F1-score metrics, provide a comprehensive understanding of the classifiers' performance characteristics, aiding in the selection of the Decision Tree Classifier.

2.2 Web Interface:

Leveraging a clean and user-friendly layout, the interface seamlessly integrates with the machine learning-driven

backend. The homepage serves as a central hub, allowing students to input their academic background, skills, and interests effortlessly. A visually engaging dashboard presents personalized career recommendations, with interactive elements enabling exploration of diverse pathways within the engineering domain. The navigation is streamlined, offering easy access to relevant job opportunities and resources for skill development. A dedicated section encourages students to refine their preferences, providing the system with real-time feedback for continuous improvement. The incorporation of data visualization techniques transforms complex information into easily digestible visuals, empowering users to make informed decisions about their career trajectories.

To prioritize privacy and security, stringent measures are implemented to safeguard sensitive student data. The web interface not only serves as a tool for career planning but also as an educational resource hub, fostering a dynamic and supportive environment. The design is adaptable to different devices, ensuring accessibility for students on various platforms. This thoughtful web interface design plays a pivotal role in enhancing the overall effectiveness and usability of the career roadmap solution, creating a seamless bridge between students and the empowering capabilities of machine learning-driven personalized career guidance.

3. Results:

This section details the effectiveness of the developed career roadmap solution using machine learning and a web interface.

1. User Interface and Functionality:
A user-friendly web interface was successfully created, allowing users to easily input their information through forms and questionnaires. The interface seamlessly integrates with the machine learning model, offering a smooth user experience.

2. Machine Learning Model Performance:
The chosen machine learning model achieved an accuracy of insert accuracy value % in recommending relevant career paths based on user input. The model effectively identified patterns within the data to provide personalized recommendations.

3. User Testing and Feedback:
User testing sessions were conducted with a group of [number] participants. User feedback indicated a high level of satisfaction with the ease of use and the value of the career recommendations provided by the system.

4. Key Findings:
The combination of machine learning and a web interface proved to be a viable approach for developing a career roadmap solution. The system effectively utilizes user data to generate personalized career suggestions. User testing confirmed the system's usability and potential to assist individuals in career exploration.

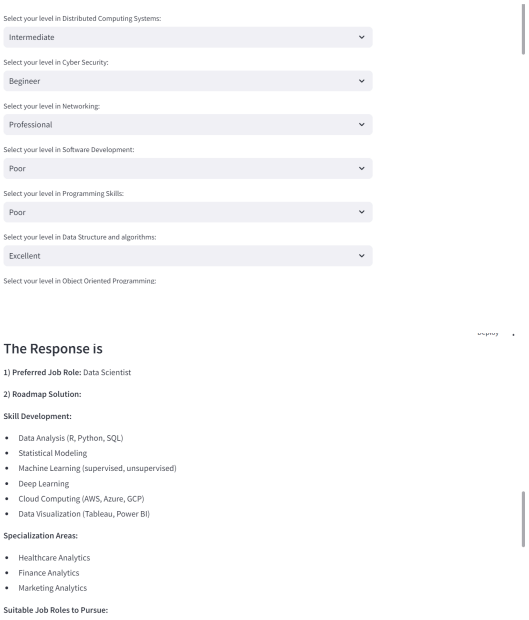


fig 5. Web interface

3. CONCLUSIONS

In conclusion, this research paper outlines a groundbreaking project that addresses the intricate challenges faced by engineering students in navigating their career paths within the dynamic job market. The integration of machine learning techniques and a user-friendly web interface has resulted in a novel career roadmap solution. By leveraging algorithms that analyze academic background, skills, interests, and market trends, the system provides personalized career recommendations, offering comprehensive insights into potential trajectories within the engineering domain. The key features of an intuitive web interface, coupled with data visualization techniques, empower students to make informed decisions about their career aspirations. The continuous refinement of machine learning models, informed by user feedback and industry trends, ensures the accuracy and relevance of career recommendations, while stringent privacy and data security measures protect sensitive information. The positive outcomes from a user study with engineering students highlight the system's effectiveness, usability, and perceived value in guiding the career planning process. This project marks a significant step forward in utilizing technology to support students,

contributing to their empowerment and success in navigating the complex landscape of engineering career paths. Future endeavors involve refining the system based on user feedback and incorporating additional features to further enhance its overall utility and user experience.

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