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ORIGINAL

Edu Scan: Optimizing talent discovery and streamlining hiring practices using AI

Edu Scan: Optimización de la detección de talentos y racionalización de las prácticas de contratación mediante IA

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ABSTRACT

Edu Scan is a machine learning-driven resume parser designed to analyse student resumes and predict their alignment with a benchmark document. The benchmark is created by aggregating key features and skills from resumes of students who have secured high-paying placements across various reputed universities. By utilizing Natural Language Processing mechanism, Edu Scan compares student resumes against this benchmark to assess familiarity and relevance. The system evaluates keyword matches, generates an accuracy score for each resume, and provides tailored suggestions for improvement. This innovative AI tool aims to optimize talent discovery by helping students align their resumes with industry standards, while assisting recruiters in streamlining the hiring process by identifying top candidates more efficiently.

Keywords: artificial intelligence; education; machine learning; natural language processing.

RESUMEN

Edu Scan es un analizador de currículos basado en aprendizaje automático diseñado para analizar los currículos de los estudiantes y predecir su alineación con un documento de referencia. El punto de referencia se crea agregando características y habilidades clave de currículos de estudiantes que han conseguido puestos bien remunerados en varias universidades de renombre. Mediante un mecanismo de procesamiento del lenguaje natural, Edu Scan compara los currículos de los estudiantes con este documento de referencia para evaluar su familiaridad y relevancia. El sistema evalúa las coincidencias de palabras clave, genera una puntuación de precisión para cada currículum y ofrece sugerencias personalizadas para mejorarlo. Esta innovadora herramienta de IA pretende optimizar el descubrimiento de talentos ayudando a los estudiantes a alinear sus currículos con los estándares de la industria, al tiempo que ayuda a los reclutadores a agilizar el proceso de contratación identificando a los mejores candidatos de forma más eficiente.

Palabras clave: inteligencia artificial; educación; aprendizaje automático; procesamiento del lenguaje natural.

INTRODUCTION

The Resume Ranking Application solves an essential problem of contemporary recruitment—optimally ranking resumes against certain vacancies depending on skill matching. As the population of graduates and job seekers

grows, institutions and recruiters experience tremendous challenges when handling and processing enormous amounts of resumes. Studies show that hiring managers look at a resume for only six to seven seconds on average, which means there is a higher chance of overlooking well-qualified candidates (Sajid et al., 2022). Furthermore, most students and job applicants have difficulty determining how well their resume aligns with industry standards, particularly for highly competitive fields like data science, software development, and web development (Bhatia et al., 2019). To fill this gap, the Resume Ranking Application uses Google's Generative AI, namely the Gemini model, to conduct high-level resume analysis and skill alignment scoring.

This method provides objective, role-based benchmarks, rendering the evaluation process more consistent and equitable. Through the use of Natural Language Processing (NLP) and machine learning, the tool increases automation in resume screening, minimizing human bias and enhancing candidate selection accuracy (Chen et al., 2018). The tool not only assists in rapidly identifying top applicants but also allows students to see how their resumes stack up against high-tier placements (Chifu et al., 2017). Prior work in resume ranking and parsing has investigated various deep learning methods. Earlier research has utilized YOLOv9 for segment detection, EasyOCR for extracting text, mBERT for classification, and GLiNER for named entity recognition, illustrating the efficacy of parsing AI models (Yazıcı et al., 2024).

Hybrid models integrating semantic similarity (based on embedding models such as gte-large-en-v1.5) and keyword-based approaches (like BM25)have enhanced ranking precision, streamlining HR decision-making (Yazıcı et al., 2024). Conventional resume parsing methods, which used rule-based methods, were limited by template dependency and inefficiencies in dealing with unstructured documents (Ayishathahira et al., 2018). Nevertheless, state-of-the-art deep learning architectures such as CNN, Bi-LSTM, and CRF have shown tremendous improvement in entity recognition and resume segmentation (Ayishathahira et al., 2018). Through the use of Generative AI and sophisticated NLP models, the suggested Resume Ranking Application maximizes recruitment effectiveness, shortens screening time, and ensures transparency and structured evaluation process. It complies with the changing needs of data-driven hiring scenarios, assisting students and recruiters in making better-informed decisions (Faliagka et al., 2017).

Literature review

This resume-ranking web application leverages deep learning to streamline recruitment by extracting and categorizing resume data using the YOLOv9 model for segment detection, EasyOCR for text extraction, mBERT for classification, and GLiNER for named entity recognition. This combination ensures comprehensive information extraction tailored to various resume formats, enhancing data accuracy and reliability. Utilizing a hybrid matching approach, the system ranks resume by comparing extracted information with job descriptions using the embedding model gte-large-en-v1.5 for semantic similarity and BM25 for keyword relevance. This dual-layered technique optimizes candidate ranking accuracy, enabling HR professionals to make more informed hiring decisions (Yazıcı., 2024).

C H Ayishathahira, C Sreejith, C Raseek et.al 2018, highlights the limitations of traditional resume parsing methods, which often rely on manual processing and specific templates. It proposes the use of advanced deep learning models, specifically CNN, Bi-LSTM, and CRF, to enhance the efficiency and accuracy of parsing unstructured documents like resumes, addressing the need for modern recruitment processes. The proposed system utilizes a combination of CNN for segment classification and Bi-LSTM-CRF for sequence labeling, allowing for the extraction of 23 specific fields from resumes. This multi-model approach aims to improve the identification and tagging of relevant entities, thereby streamlining the recruitment workflow.

Bodhvi Gaur, Gurpreet Singh Saluja et.al 2021 presents a novel semi-supervised approach to identify educational institutions and degrees from the education sections of resumes, addressing the challenge posed by the scarcity of large annotated datasets typically required for neural network-based named entity recognition techniques. This methodology allows for effective entity extraction without relying heavily on extensive labeled data. The proposed deep neural network model demonstrates significant performance improvements through iterative training and correction of predicted entities, achieving an accuracy of 92,06 % in the named entity recognition task. This indicates the effectiveness of the model in accurately identifying and extracting relevant educational information from resumes, thereby enhancing machine processing capabilities.

Sajid, Hira, et al. 2022, The paper identifies key challenges in the recruitment process due to the variety of resume formats and styles, which complicate data mining operations like information extraction and applicant ranking. Existing methods, including rule-based and supervised approaches, are limited by their reliance on large amounts of annotated data and can lead to knowledge incompleteness, adversely affecting the accuracy of resume parsers.

The proposed resume parsing framework addresses the limitations of previous techniques by implementing a systematic approach that first extracts raw text and classifies text blocks, followed by named entity recognition and ontology enrichment. This comprehensive methodology enhances the accuracy of information extraction from resumes, ultimately facilitating the identification of the best candidates for recruitment.

Ramakrishnan, Cartic, et al. 2012, presents the Layout-Aware PDF Text Extraction (LA-PDFText) system, designed to facilitate accurate extraction of text from PDF files of research articles. This system addresses the challenges faced in biomedical text mining and biocuration informatics by providing a layout-aware approach for extracting text in a

logical and organized manner, focusing solely on the textual content of research articles. The LA-PDFText system operates in a three-stage process—detecting text blocks, classifying them into rhetorical categories, and stitching them together for coherent extraction. The system achieved impressive performance metrics, with Precision of 96 %, Recall of 89 %, and F1 score of 91 %. Additionally, the paper discusses comparisons with other systems, such as PDF2Text, highlighting its accuracy and identifying areas for further improvement through preliminary error analysis.
Wahl, Friedrich M., Kwan Y. Wong, and Richard G. Casey, et al. 1982, The paper demonstrates that a constrained run length algorithm effectively segments and classifies digitized printed documents into distinct regions of text, solid black lines, and areas containing graphics and images. This approach utilizes the consistent structure of text lines as textured stripes, enabling the development of a linear adaptive classification scheme to accurately differentiate text regions from other document areas, thus enhancing the efficiency of document analysis systems.
Ranjan, Arti, and M. Ravinder et al.2024, This book chapter highlights the challenges of extracting text from blurred images using traditional methods and emphasizes the role of NLP-based post-processing techniques in enhancing text extraction accuracy. It discusses the integration of machine learning algorithms, such as convolutional neural networks, to improve the performance of these NLP techniques, ultimately demonstrating their effectiveness through a case study that showcases improved text extraction outcomes from low-quality images.
Kushol, Rafsanjany, Imamul Ahsan, and Md Nishat Raihan et al. 2018, The paper presents an innovative Android application framework designed to process text captured from images of business cards and promotional materials, utilizing Google Cloud Vision API for text retrieval and OpenNLP for information extraction. The experimental results demonstrate that the application effectively and efficiently retrieves contact and event information, showcasing high accuracy and fast processing times in real-world scenarios. Joshi, Neha et al. 2019, The paper presents a text mining application that recognizes and summarizes text from images, emphasizing the importance of deriving quality information from large datasets. The application allows users to specify the desired number of summary lines, thus providing a personalized experience that enhances data efficiency and saves time. By optimizing the model for text image extraction and summarization, it aims to create a user-friendly tool that can be utilized in various scenarios, improving analytics capabilities for large volumes of data.
Chandola, Divyanshu, et al. 2015, The paper proposes a text analytic approach to streamline the resume evaluation process for HR departments, addressing the challenges of sifting through numerous resumes. By incorporating sentiment analysis, the approach aims to assess candidates based on the content and descriptions in their resumes, ultimately aiding employers in identifying the most suitable candidates for job openings. This innovative methodology seeks to reduce the likelihood of misjudging candidates and optimize resource allocation in the hiring process.
Bhatia, Vedant, et al. 2019, The paper introduces an end-to-end solution that addresses the challenges employers face in manually evaluating a growing number of job applications. The proposed system consists of a resume parser, which extracts comprehensive information from resumes and is accessible as a public web application, followed by a BERT-based sentence pair classification method to rank candidates based on their alignment with job descriptions. The system demonstrates high accuracy, achieving 100 % accuracy in parsing LinkedIn resumes and establishing a baseline of 73 % accuracy for assessing candidate suitability, thus providing a robust tool for enhancing the recruitment process.
Chen, Jie, Chunxia Zhang, and Zhendong Niu et al.2018, The paper proposes a two-step approach for resume information extraction to address the challenges posed by diverse resume formats that hinder effective data mining. In the first step, it identifies the raw text of resumes by segmenting them into different blocks using a novel feature called Writing Style, which incorporates sentence syntax, word indices, punctuation indices, lexical attributes, and classifier predictions. In the second step, multiple classifiers are utilized to identify various attributes of factual information within resumes, demonstrating the feasibility and effectiveness of the algorithm through experiments conducted on a real-world dataset.
Chifu, Emil St, et al.2017, The paper introduces a novel method for detecting professional skills from resumes using an ontology of skills, multi-word part-of-speech patterns, and the Wikipedia encyclopedia. This method not only identifies known skills from the ontology but also attempts to discover new skills through a bootstrapping approach that utilizes specific lexicalized expression patterns. The newly detected skills are validated by experts and incorporated into the ontology, enhancing the system's ability to evolve and adapt to emerging skill sets in the job market.
Faliagka, Evanthia, Athanasios Tsakalidis, and Giannis Tzimas et al.2017, This paper presents a novel e-recruitment system that automates the pre-screening of job applicants by extracting objective criteria from LinkedIn profiles and deriving personality traits through linguistic analysis. The system employs the Analytical Hierarchy Process (AHP) to rank candidates based on criteria controlled by recruiters. Its effectiveness was validated in a real-world scenario, demonstrating consistent performance compared to human recruiters, thereby enhancing the efficiency of the recruitment process.
Goyal, Umang, et al 2021, The proposed system simplifies the hiring process by allowing employers to upload resumes in various formats (.pdf, .doc, .rtf, etc.), which are then converted into a standardized text format. The program automates the extraction of relevant information from the resumes and organizes the data in a defined format, enabling users to download the results in .CSV format, thereby streamlining data management in recruitment.

Srivastava, Rajiv, Girish Keshav Palshikar, and Swapnil Hingmire, et al 2008, The RINX system is designed to extract diverse information elements from resumes by leveraging deep syntactic, linguistic, and domain knowledge, facilitating critical tasks such as candidate selection, team formation, and market intelligence gathering within organizations.
Kudatarkar, Vinaya Ramesh, Manjula Ramannavar, and S. S. Nandini et al, 2015, presents an unstructured text analytics approach aimed at organizing and understanding the rapidly increasing volume of textual data, specifically focusing on qualitative evaluation of CV/Resume documents. The proposed method effectively extracts resume information from websites and assesses resumes based on parameters such as coverage, readability, and comprehensibility, thereby facilitating the identification of suitable candidates.
Sainani, Abhishek, and P. K. Reddy et al, 2011, proposes an efficient framework for information extraction from resumes to address the challenge of selecting suitable candidates from a large pool of similar resumes. It highlights the necessity of automated data extraction techniques to streamline the selection process for employers, allowing for better handling of the overwhelming volume of applications received by corporations, thus enhancing the efficiency of the recruitment process.
Koh, May Fern, and Yew Choong Chew et al 2015, introduces a methodology for job matching that goes beyond traditional methods by incorporating user-provided parameters such as job domain, title, and experience, along with employing a self-learning engine to autofill missing information in resumes. This approach utilizes ontology for data inference, allowing the system to discover new relationships among parameters and improve consistency, ultimately enhancing the accuracy and effectiveness of the job matching process.
Anami, Renuka S., and Gauri R. Rao et al, investigates methods to enhance the resume selection process for enterprises inundated with thousands of applications. By extending the concept of special features, the authors propose an approach that identifies resumes with unique skills, facilitating better candidate selection despite the challenges posed by unformatted and semi-formatted text. Experimental results indicate that the proposed method can effectively extract structured information from resumes, thereby improving the efficiency of resume management and routing within human resource systems.

METHOD

Figure 1 is representing workflow of the proposed method to discover talent people by parsing resumi using natural language processing mechanism. This streamlines the hiring process of jobs.

Algorithm

Input

Users can upload a list of PDF resumes and users select the desired job role for which the resumes will be evaluated.

1. Load Environment Variables: Utilize dotenv to access the Google API key necessary for various functionalities.
2. Configure AI Client: Set up the Generative AI client using the retrieved API key.
3. Define Constants: Create a dictionary called ROLE_SKILLS that maps each job role to its corresponding skill set requirements.
4. Accepts a list of PDF files and Reads each file and extracts text using the PyMuPDF library (fitz) and Concatenates and returns text from all pages of each PDF.
5. Text Chunking is done using Raw text extracted from resumes and Splits the text into manageable chunks using Recursive Character Text Splitter and Returns a list of text chunks for further processing.
6. Vector Store Creation Generates embeddings for the text chunks using Google Generative AI Embeddings and Creates and saves a FAISS vector store locally for efficient retrieval.
7. Conversational Chain setup is done Establishes a Q&A chain utilizing a Generative AI model.
8. Custom Prompting: Uses a tailored prompt template to answer questions based on the context provided by the resumes.
9. User Query Handling: Accepts user queries and relevant text data.
10. Skill Alignment Calculation is done

Output

Display ranked resumes along with their alignment scores and matched skills.
Provide responses to user queries related to the resumes.

Error Handling

Implement mechanisms to manage errors such as file upload issues, missing data in Excel files, and other exceptions that may occur during processing.
This structured approach ensures that the Resume Ranking Application efficiently evaluates candidates, enhancing the recruitment process through automation.

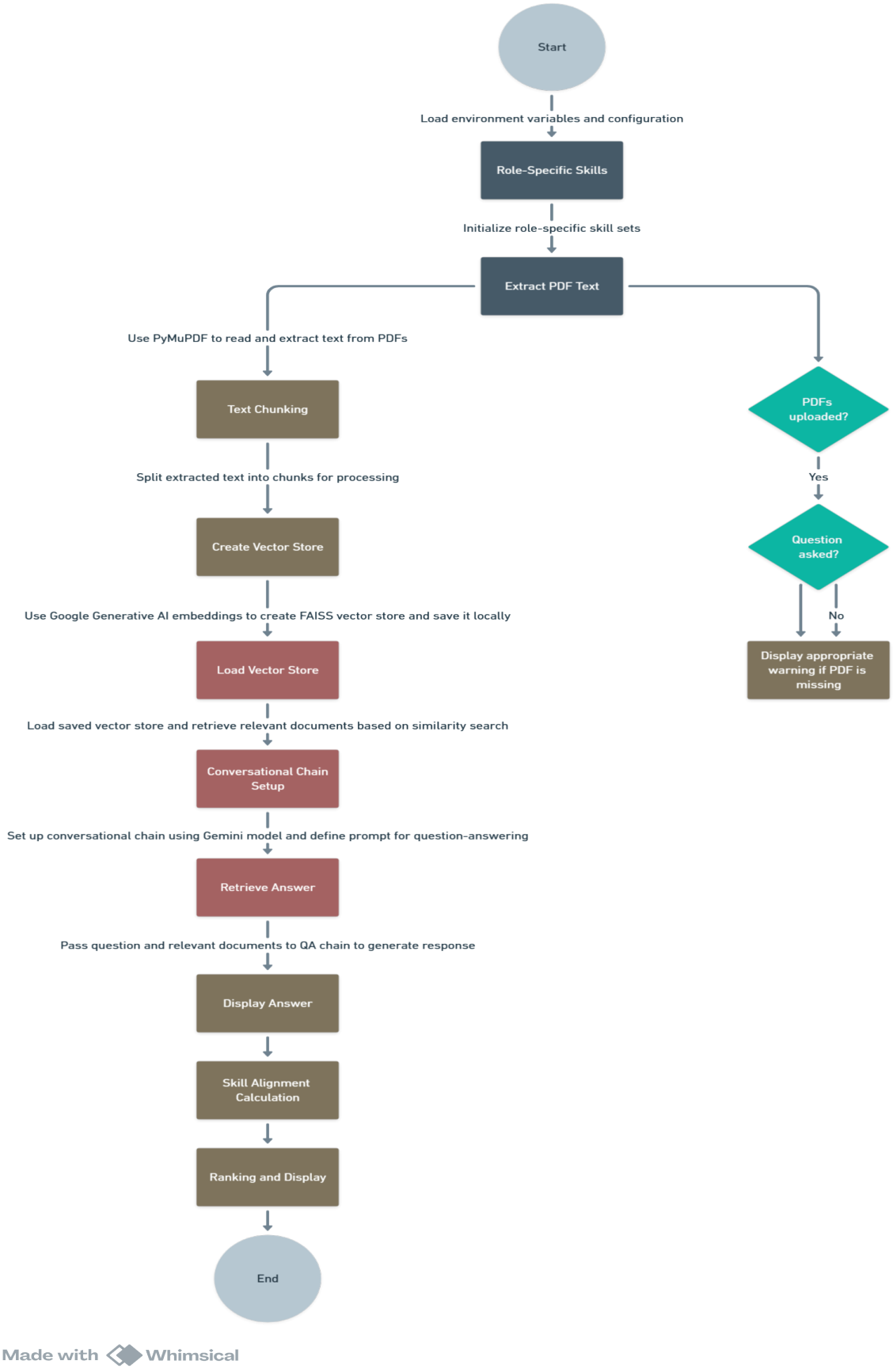

Figure 1. Optimizing Talent Discovery and Streamlining Hiring Practices

Data Exploration

The dataset represents a structured collection of resume file paths, designed to facilitate the automated processing, extraction, and ranking of resumes. It primarily aims to assist in analyzing resumes in PDF format for various purposes, such as skill matching, keyword extraction, and ranking based on predefined job roles or requirements.

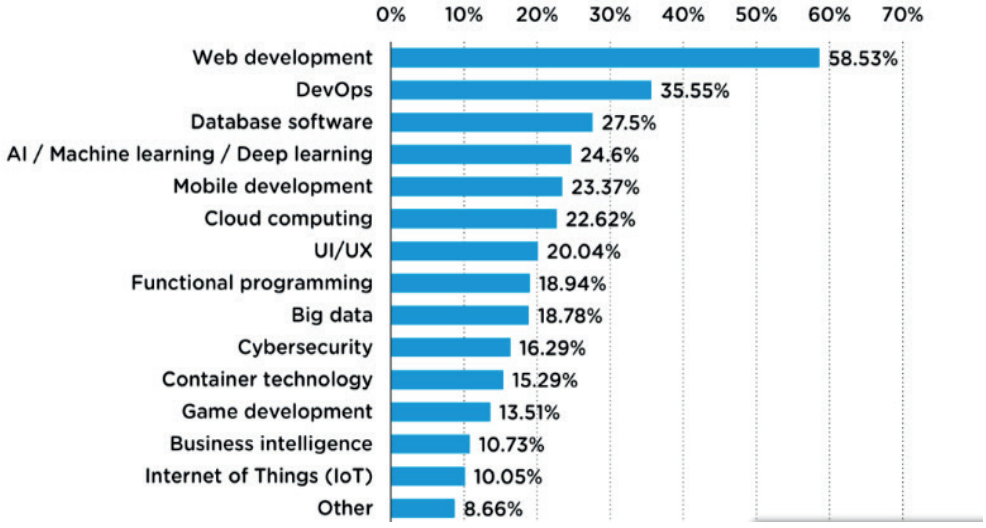

Figure 2. Key Skills

The State of Tech Hiring 2023 report, released by CodinGame and CoderPad, provided valuable insights into the technology market, including the key skills sought out by companies in their search for talent. Recruiters are expected to seek out more full-stack developers due to the high demand for web development skills in the market. Additionally, professionals in machine learning and big data will continue to be sought after as demand grows.

RESULT DISCUSSION

The main objective of this work is to rank resumes by examining their content and aligning them with specific job roles based on relevant skills. By leveraging machine learning models and Natural Language Processing (NLP) techniques, the project aims to automate the evaluation of resumes in relation to predefined job descriptions.

A web application is designed for creating user friendly environment. Figure 3 is representing the tab to enter the job role. Figure 4 and 5 representing the resume ranking based on job role entered by the user.

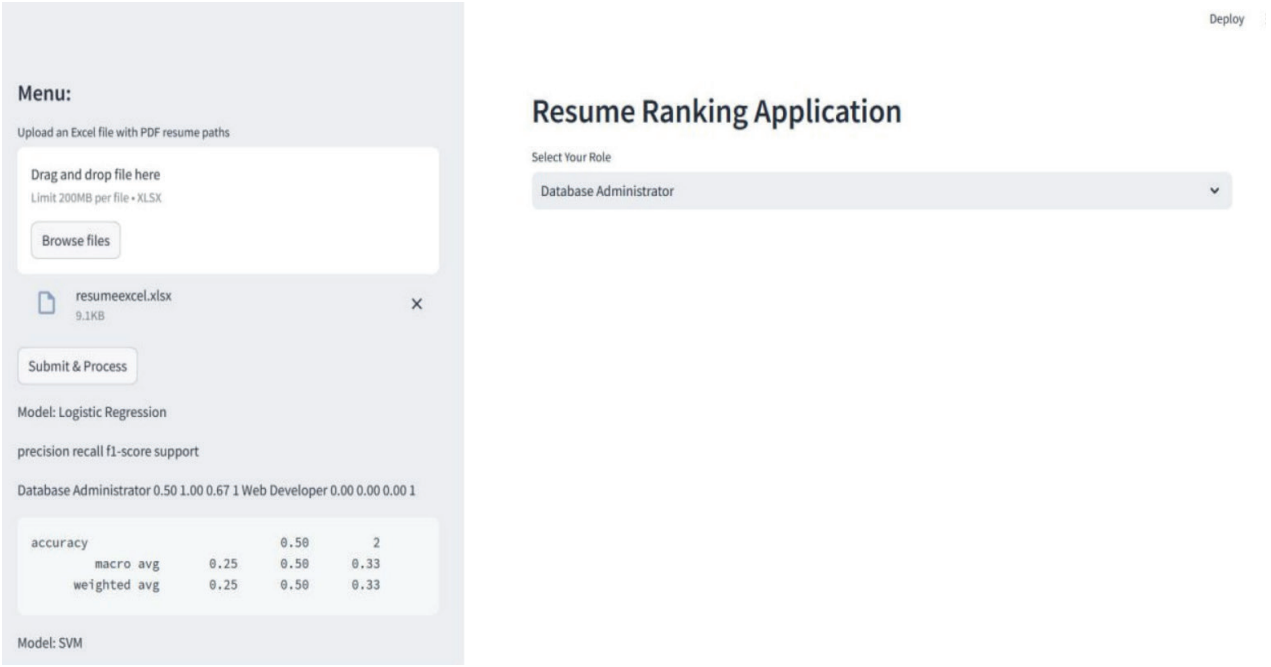

Figure 3. User Interface of Resume Ranking Application

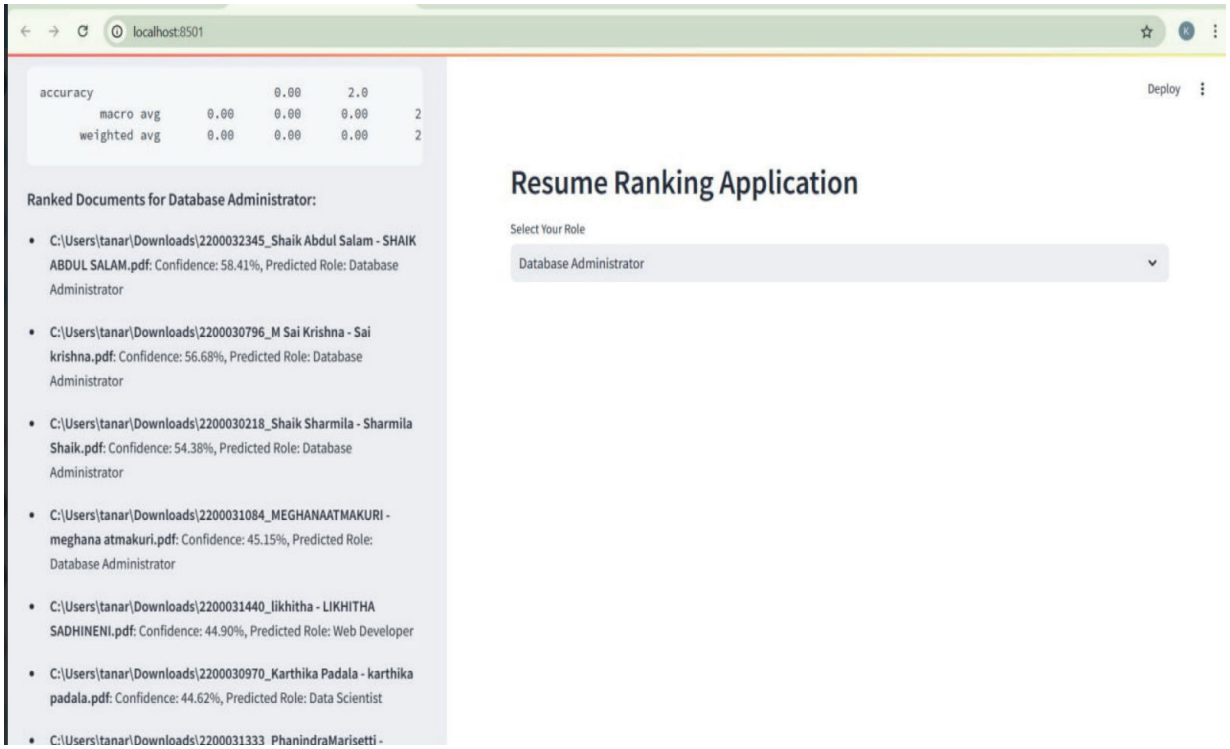

Figure 4. Ranking of the resumes based on the given role database administrator

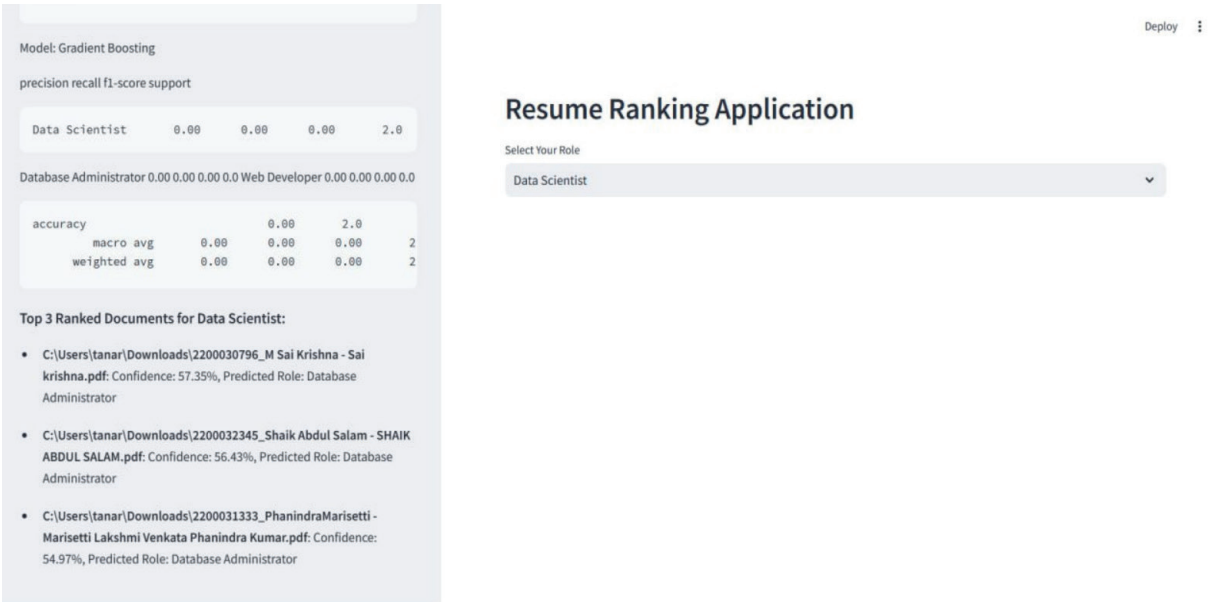

Figure 5. Ranking of the resumes based on the given role data scientist

The resume ranking project utilizes PyMuPDF to process and extract relevant information from resumes in PDF format. The extracted text undergoes preprocessing and is transformed into numerical features using TF-IDF vectorization. Various machine learning models, including Logistic Regression, Support Vector Machines (SVM), Random Forest, K-Nearest Neighbors, Naive Bayes, and Gradient Boosting, were trained to classify resumes based on their skill sets. Among these models, Gradient Boosting consistently delivered the highest accuracy, as evidenced by classification reports that highlighted precision, recall, and F1-scores. The top-performing model was employed to predict job roles for each resume and calculate confidence scores, which reflect the likelihood of a match with the specified role. Resumes were subsequently ranked according to these confidence scores, with those scoring higher indicating a stronger alignment with the required job skills.

The application features a user-friendly interface powered by Streamlit, allowing recruiters to upload resumes, select desired roles, and view the ranked results. The TF-IDF vectorization effectively captured essential keywords and skills, ensuring that the predicted roles closely matched predefined job requirements. This project automates the manual

evaluation of resumes, significantly reducing time and effort involved in the recruitment process. Although challenges such as resumes lacking sufficient text or errors in file processing were encountered, they did not detract from the overall effectiveness of the system. By leveraging machine learning to automate classification, the project enhances recruitment efficiency and precision, enabling recruiters to concentrate on the highest-ranked resumes and optimize their hiring processes.

CONCLUSION AND FUTUREWORK

This work argues the efficiency and accuracy of machine learning when ranking resumes compared to conventional recruitment processes that rely on effort and even individual bias. Since this system uses multiple algorithms, it allows ranking candidates objectively according to their skills relevance to a particular role. Results suggest practical feasibility for such a system in reducing recruiter workload while improving matches. Therefore, Logistic Regression as well as Random Forest emphasize the strategy of using appropriate models according to characteristics in datasets. There is a great deal of scope for improvement and expansion in this system. The first major area of future enhancement would be integration with advanced NLP models that include BERT or GPT so that one could better understand semantics in the resume content and capture nuanced descriptions of skills. This would allow for much deeper processing and better representation of resumes. Additional dynamic, on-the-fly skill-matching can be incorporated feature; the recruiter may fill on-the-fly job-specific skills and have the system readily accommodate changes in requirements and industry and sector-based trends. Another major enhancement that could be made is to incorporate more advanced resume parsing mechanisms that handle the various forms of the layout and file-type resumes while striving for uniformity in text extraction.

From an operational standpoint, hosting this system on a cloud-based architecture with real-time processing capabilities would make it prime for large-scale applications in an enterprise setting. Some feature ideas for this could include user authentication, secure data handling, and then dashboard interfaces through which recruiters could monitor and manage ranked resumes effectively. Moreover, ethical AI practices towards bias detection and mitigation would ensure fairness in the evaluation of candidates while promoting equitable hiring practices. Last but not least, the system could be extended to include applicant tracking feature integration that harmoniously will sing along with the other HR tools to result in an integrated recruitment platform ranking resumes from within these end-to-end hiring workflows.

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Writing - review and editing: Meghana Atmakuri, Kanthi Rekha Tanari, Balabadra Navya Sri, M Kavitha, Dharmaiah Devarapalli, M Kalyani, D Mythrayee.