AI-powered Resume Screening and Ranking System

A Project Report

submitted in partial fulfillment of the requirements

of

AICTE Internship on AI: Transformative Learning
with
TechSaksham – A joint CSR initiative of Microsoft & SAP

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ACKNOWLEDGEMENT

ABSTRACT

The recruitment process is also becoming more and more difficult with the flood of applications received for every advertisement posted. Resume screening is a labor-intensive task, vulnerable to bias, and not very efficient. This project, "AI-Powered Resume Screening and Ranking System," seeks to automate and maximize the shortlisting of candidates through Natural Language Processing (NLP) and Machine Learning methods. This system enables administrators to make job postings with informative requirements, enabling several users to upload PDF resumes. The uploaded resumes are vectorized and ranked based on TF-IDF and cosine similarity to indicate how relevant they are to the job description. Most importantly, the system automatically gives greater weight to skills mentioned verbatim as required in the job description, enhancing the accuracy of the ranking. The system is developed with Streamlit for an easy-to-use web interface and SQLite for optimized data handling. The backend uses PyPDF2 for extracting text from PDFs and Scikit-learn for similarity calculations. This AI-based system minimizes the manual labor involved in candidate screening, enhances decision-making accuracy, and facilitates a more objective and unbiased screening process.

Major Contributions:

Automated Resume Screening: Identifies principal information (skills, experience, education) from resumes.

AI-Based Ranking: Uses TF-IDF and cosine similarity to rank resumes against job descriptions.

Dynamic Skill Weightage: Gives priority to resumes with the needed skills to do the job.

User-Friendly Interface: Built with Streamlit for an effortless user experience.

Scalability and Efficiency: Designed to process multiple job postings and high volumes of resume uploads.

Through the use of this system, recruiters are able to automate the hiring process, enhance candidate shortlisting effectiveness, and improve the overall recruitment process. This project illustrates the power of AI in HR technology and provides a platform for future development of automated recruitment tools.

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CHAPTER 1

Introduction

1.1 Problem Statement:

The conventional hiring process, as it exists today, is a major bottleneck in the recruitment process, primarily plagued by the sheer volume of applications that are received for every and any job posting. The manual scanning and shortlisting of resumes is not only time-consuming but also an inefficient process that is largely prone to a number of subjective biases and inconsistencies. Recruiters are often in a tricky position as they try to sift through the best candidates from a diverse group within a limited timeframe, confronted with a number of challenges that stem from the unstructured nature of most resumes, the varying levels of detail that are offered, and the inherent subjectivity that stems from the assessment of candidate qualifications. This tends to lead to a huge investment of time and resources, which can lead to delays in the hiring process and negatively impact the overall efficiency of the organization as a whole. In light of these key issues, this project, entitled "AI-Powered Resume Screening and Ranking System," is specifically aimed at addressing these issues directly by automating the assessment process through the use of advanced Natural Language Processing (NLP) and Machine Learning algorithms. The innovative system is able to process resumes that are submitted in PDF format, skillfully extracting key information such as skills, experience, and educational background, and then generating a ranked list of candidates based on their relevance to the specific job description that has been offered. Through the use of this cutting-edge AI-driven process, the system ensures a much quicker, unbiased, and accurate candidate shortlisting process, significantly minimizing the manual effort involved and maximizing the objectivity of hiring decisions. Overall, this project provides a scalable and highly efficient solution for companies and HR professionals who are seeking to streamline their recruitment workflow, thus making the entire hiring process not only more effective but also substantially fairer.

1.2 Motivation:

In the job market today, which is very competitive and fast-paced, recruiters often receive hundreds or even thousands of applications for each job opening. This large number of resumes makes the hiring process slow and difficult. Looking through each resume by hand takes a lot of time and can be wasteful. Also, personal opinions can lead to mistakes or unfair treatment when people review resumes.

Noticing the need for a fair and efficient way to review resumes, and because I'm interested in artificial intelligence and automation, I decided to create something new: the AI-Powered Resume Screening and Ranking System. The main goal of this system is to fairly and efficiently evaluate resumes by automatically ranking them using advanced techniques like TF-IDF vectorization and cosine similarity. This allows us to find the best candidates for a job without needing humans to review each resume, which reduces the chance of errors or bias.

This project also gives me the opportunity to try out real-world applications of artificial intelligence, learn more about text processing and ranking methods, and add valuable tools to the growing field of AI in human resources. Ultimately, this system aims to make the recruitment process better by reducing the workload on recruiters, eliminating biases, and improving the accuracy of hiring decisions. This will make hiring more data-driven, fair, and efficient for everyone involved.

1.3 Objective:

The primary objective of this project is to develop an AI-powered Resume Screening and Ranking System that automates the resume evaluation process, ensuring efficiency, accuracy, and fairness in candidate shortlisting. The system leverages Natural Language Processing (NLP) and Machine Learning techniques to analyze resumes and rank them based on their relevance to a given job description.

Specific Objectives:

Automate Resume Screening:

- Extract key information such as skills, experience, and education from resumes.
- Process resumes in PDF format to ensure compatibility with common document formats used in recruitment.

Develop an AI-Based Ranking System:

- Implement TF-IDF vectorization and cosine similarity to measure the relevance of resumes against job descriptions.
- Assign higher weightage to required skills mentioned in the job description to improve ranking accuracy.

Ensure a Scalable and User-Friendly System:

- Build a Streamlit-based web interface that allows easy job creation and resume uploads.
- Store job postings and resumes in an SQLite database to ensure efficient data management.

Improve Efficiency and Fairness in Recruitment:

- Reduce the time and manual effort required for resume shortlisting.
- Provide a data-driven, unbiased approach to candidate ranking, minimizing human bias in the hiring process.

Enhance Practical Knowledge in AI and NLP:

- Gain hands-on experience in text processing, ranking algorithms, and AI-driven decision-making.
- Explore real-world applications of AI in Human Resource Technology to optimize the hiring process.

By achieving these objectives, the system provides an effective, AI-driven solution for recruiters and HR professionals, ensuring a more efficient, objective, and scalable approach to resume evaluation and candidate selection.

1.4 Scope of the Project:

The AI-Powered Resume Screening and Ranking System is designed to automate the often-laborious resume evaluation process, enhancing efficiency, scalability, and objectivity in candidate shortlisting. This project focuses on creating an AI-driven solution that efficiently processes resumes, extracts relevant information, and ranks candidates based on their suitability for a specific job description.

In-Scope Features:

● Resume Processing and Data Extraction: The system accepts resumes in PDF format and extracts text content. Crucially, it identifies key sections, including skills, experience, and education, leveraging Natural Language Processing (NLP) techniques.

● AI-Based Resume Ranking: The system uses TF-IDF vectorization and cosine similarity to determine the relevance of a resume to a given job description. A key feature prioritizes required skills mentioned in the job description to improve the accuracy of the ranking algorithm.

● User-Friendly Interface: A Streamlit-based web interface facilitates job posting creation and resume uploads. The interface presents candidate rankings in a clear, leaderboard-style format for easy review.

● Data Management and Scalability: The project utilizes an SQLite database to store job postings and resumes, enabling support for multiple job postings and bulk resume uploads.

Out-of-Scope Features:

● Advanced AI Models: The initial implementation does not utilize deep learning-based NLP models (such as BERT or GPT) for enhanced semantic understanding. The system's accuracy relies on TF-IDF and cosine similarity, which while effective, does not leverage the potential of pre-trained transformers; this will be considered for future iterations.

● Multi-Language Support: The system currently processes English-language resumes only. Future enhancements may include support for multiple languages.

● External System Integration: The project does not integrate with Applicant Tracking Systems (ATS) or job portals. Future versions may incorporate API-based integration to facilitate seamless data flow with other HR systems.

Potential Future Enhancements:

- Predictive Capabilities: Machine learning classifiers could be implemented to predict a candidate's potential for success in the role, moving beyond simple matching to include predictive modeling.
- Automated Feedback and Suggestions: AI analysis could provide tailored feedback on resumes, offering suggestions for improvement based on the identified strengths and weaknesses relative to the job description.
- Expanded Document Format Support: Adding support for additional document formats (DOCX, TXT, etc.) would enhance the system's versatility.
- Enhanced Resume Parsing: Refining the resume parsing algorithm could improve accuracy in extracting structured data like dates and job titles.

This project lays a solid foundation for AI-driven recruitment automation, with potential for significant enhancements and expansion in future iterations to further improve efficiency, accuracy, and usability in the hiring process.

CHAPTER 2

Literature Survey

2.1 Review relevant literature or previous work in this domain.

Recent studies that have been carried out in the field of automated resume screening and candidate ranking have put a lot of focus on utilizing state-of-the-art Natural Language Processing (NLP) and novel machine learning methods, both of which focus on improving and optimizing the recruitment process. In the initial phases of this evolution, the methods used were mostly rule-based systems, which were mostly dependent on manually coded rules in an attempt to extract useful information like skills, professional experience, and academic records from the resumes presented by candidates. Although these systems were designed with a particular goal, they were tested when handling the diversity and unstructured format of the various forms in which resumes can be presented.

As time went on and technology evolved, researchers started applying different statistical techniques combined with supervised learning models in their research, all aimed at greatly improving accuracy. Of these methods, techniques such as TF-IDF vectorization, when combined with cosine similarity, have been effective in measuring the relevance of the content within resumes in comparison to given job descriptions. For example, many studies have undoubtedly shown that by converting the textual data contained within resumes into numerical vectors, it is possible to compare candidate profiles to the given job requirements systematically and achieve measurable precision in the assessment process.

More recently, transformer-based architectures (e.g., BERT) and deep learning models have been investigated in order to uncover the semantic subtleties within resume data. These models have been demonstrated to be capable of contextual understanding along with minimizing bias, but the high resource usage and complexity may act as a limiting factor in practical implementation across most organizations. A hybrid solution that integrates the use of classical NLP approaches with strategic use of deep learning elements is thus surfacing as an attractive alternative.

In addition, transparency and fairness are emphasized by research as being of greatest significance in computer-assisted resume screening. Precautions against algorithmic bias have been suggested by researchers so that candidate ranking will continue to be objective and equitable. Such continuous development makes it all the more critical to have systems that, apart from maximizing efficiency, maintain ethical standards in recruitment. Briefly, the extensive body of literature in this specific field reflects an

impressive development that moves from relatively simple rule-based systems to much more sophisticated and intricate AI-based models. Each alternative method has its own intrinsic advantages as well as disadvantages, and recent trends indicate a greater preference towards methods that effectively integrate a variety of key factors like accuracy, computational complexity, and fairness. This particular project builds upon such significant findings by integrating well-established practices like TF-IDF vectorization and cosine similarity with new dynamic weighting schemes that prioritize key skills. In doing so, it attempts to provide a successful and resilient solution that addresses the modern challenges of resume screening processes.

2.2 Mention any existing models, techniques, or methodologies related to the problem.

Over the past few years, a variety of different approaches has been created and improved to efficiently automate the process of resume screening, a process that has become very critical in most industries. In the initial stages, the systems that were created mostly utilized rule-based approaches, where subject matter experts spent time hand-coding specific rules that would be utilized to extract vital information from resumes—information that comprises vital information such as skills that the applicants have, their work experience, and their educational background. Even though these initial systems provided a good foundation for future developments in the field, they were greatly handicapped by the high variability and unstructured nature of resumes that were encountered in real-world applications.

As data-driven methods started to develop and become increasingly popular among researchers, more and more researchers became interested in using statistical methods and machine learning models. For example, the use of TF-IDF vectorization and cosine similarity became very popular as a practical method to convert the text data present in resumes and job descriptions into numerical vectors. These numerical vectors enabled quantitative comparisons between documents, and quantitative analysis became easier. Additionally, several supervised models have been well researched and examined, such as logistic regression, support vector machines (SVM), decision trees, and random forests. These models are used to classify resumes according to their relevance to job descriptions or to predict the fitness of candidates for jobs based on past hiring decisions.

In more contemporary times, several methods within the realm of deep learning—most significantly those transformer model-based, like the highly popular BERT model—have been very effective in their ability to grasp the complex semantic subtleties present in text-based data. These newer models possess the wonderful capability of understanding and deciphering context, which is particularly helpful when examining the varied and complex language typically present in resumes. That being said, it needs to be noted that based on their inherent computational complexity, most

real-world systems tend to take advantage of the strengths of deep learning while implementing traditional methods. This tactical approach results in the development of hybrid systems that attempt to attain the best possible compromise between performance parameters and operational efficiency.

Other methods used within this scope include the use of Named Entity Recognition (NER) for the purposes of extracting automated structured data including skills, certification, and the number of years of experience in resumes. Still, other techniques used involve methods of clustering the candidate profiles by categorizing similar profiles and organizing them for effect. In most cases, the methodologies used here are dynamically weighted, such that they adapt on the basis of some criteria and ensure resumes with keywords for a particular job application are ranked more highly within the evaluation. In short, the variety of available solutions ranges from the conventional rule-based systems to more sophisticated and intricate artificial intelligence models. The wide variety of methodologies not only offers a list of alternatives but also allows organizations to personalize and adjust their resume screening procedures as per their needs. Moreover, the alternatives consider the computational resources available to them, as well as the trade-off they wish to have between interpretability and prediction ability in their decision-making process.

2.3 Highlight the gaps or limitations in existing solutions and how your project will address them.

Despite significant progress in automated resume screening, existing solutions exhibit several limitations:

- Complexity and Computational Overhead:

    Many state-of-the-art models, particularly deep learning approaches like BERT, offer excellent semantic understanding but at the cost of high computational resources. This complexity makes them less accessible for organizations with limited infrastructure.

- Handling Unstructured Data:

    Traditional rule-based systems often struggle with the variability and unstructured nature of resume formats. These systems can miss subtle context or relevant information, leading to less accurate candidate ranking.

- Lack of Dynamic Weighting:

    Most existing methods do not adequately adjust their evaluation criteria based on the specific skills or requirements of a job posting. Without dynamic weighting,

resumes that contain critical job-specific skills might not receive the emphasis they deserve.

● Limited Integration and Usability:

Many solutions are designed as standalone systems with limited integration into existing HR workflows. They often lack user-friendly interfaces, making them challenging to deploy in real-world scenarios.

2.3.1 How This Project Addresses These Gaps:

● Balanced Approach:

This project leverages established NLP techniques—such as TF-IDF vectorization and cosine similarity—to provide a computationally efficient solution. By avoiding overly complex deep learning models, the system remains accessible without sacrificing performance.

● Dynamic Skill Weighting:

The proposed system introduces a dynamic weighting mechanism that boosts the ranking of resumes containing key job-specific skills. This approach ensures that candidates whose resumes closely match the job requirements are prioritized, addressing the shortcomings of static evaluation methods.

● Improved Handling of Unstructured Data:

By incorporating targeted text extraction techniques to identify key sections (skills, experience, education) from resumes, the system effectively manages the unstructured nature of resume content, leading to more accurate evaluations.

● User-Friendly and Scalable Design:

The project utilizes Streamlit for an intuitive web interface and SQLite for efficient data management, enabling seamless integration into existing HR workflows. This design ensures that the solution is not only powerful but also easy to deploy and use in practical settings.

In summary, the project bridges the gap between advanced AI methodologies and practical, scalable deployment, providing an efficient, dynamic, and user-friendly system for resume screening and ranking.
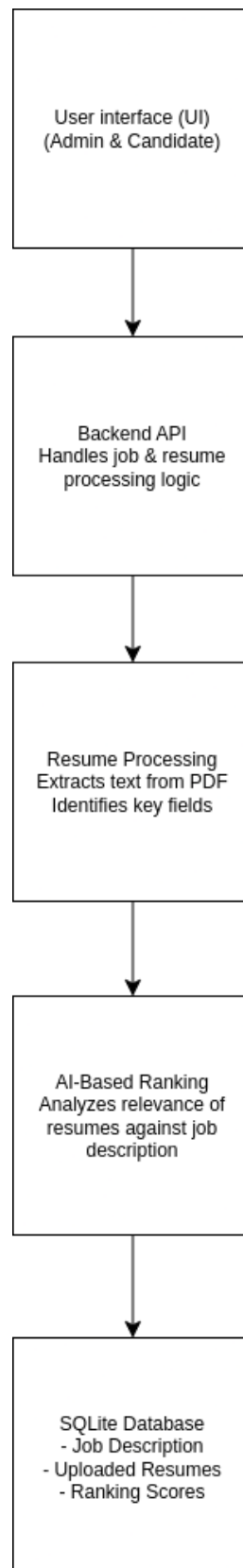
CHAPTER 3
Proposed Methodology

3.1   System Design

The AI-Powered Resume Screening and Ranking System is designed with a structured approach that ensures efficient resume processing, ranking, and user interaction. The system consists of multiple components, including frontend (Streamlit UI), database (SQLite), text processing (NLP), and ranking (TF-IDF + Cosine Similarity).

High-Level Architecture:

The system follows a three-layer architecture:

- Presentation Layer (Frontend - Streamlit): User-friendly interface for job posting, resume uploads, and leaderboard display.
- Application Layer (Backend - Python, NLP, and AI Ranking System): Processes job descriptions and resumes, extracts key sections, and applies AI-based ranking.
- Data Layer (Database - SQLite): Stores job postings and uploaded resumes.

User interface (UI)
(Admin & Candidate)

Backend API
Handles job & resume
processing logic

Resume Processing
Extracts text from PDF
Identifies key fields

AI-Based Ranking
Analyzes relevance of
resumes against job
description

SQLite Database
- Job Description
- Uploaded Resumes
- Ranking Scores

[Figure 1]

Workflow Diagram:

Start → System is initialized when the admin or user accesses the interface.

Admin Job Posting → Admin enters the job title and description, which is stored in the database.

Decision → Checks if a candidate has uploaded a resume.
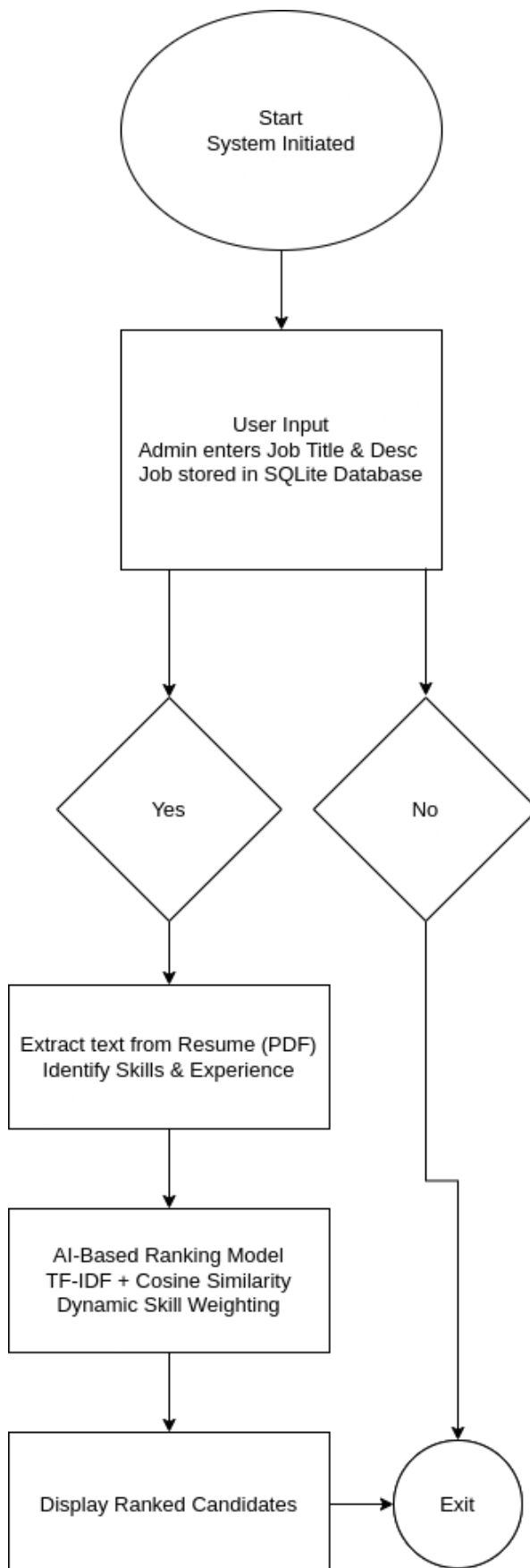
      If **yes**, continue with processing.

      If **no**, exit the system.

Resume Processing→ Extracts text, skills, experience, and education from the uploaded PDF.

AI-Based Ranking→ Uses TF-IDF and cosine similarity to rank resumes dynamically.

Ranked Candidates Display → Shows ranked resumes in leaderboard format on the UI.

End → The process completes once rankings are displayed.

Start
System Initiated

User Input
Admin enters Job Title & Desc
Job stored in SQLite Database

Yes

No

Extract text from Resume (PDF)
Identify Skills & Experience

AI-Based Ranking Model
TF-IDF + Cosine Similarity
Dynamic Skill Weighting

Display Ranked Candidates

Exit

[Figure 2]

Database Design Shapes:

jobs table:

- Stores job details including job title and description.
- Each job has a unique ID.

resumes table:

- Stores uploaded resumes along with the associated job ID.
- Includes filename, extracted text content, and AI-generated score.
- The ranking score helps in sorting candidates from most to least relevant.

id	title	description
1	Software engineer	aws cloud or azure or google cloud

id	job_id	file_name	content	score
1	1	twitter-full-stack-engineer-resume-example-novwB.pdf	clyda clavier full stack engineer profile highly motivated full stack engineer …	0.599363076649932

3.2   Requirement Specification

The AI-Powered Resume Screening and Ranking System is built using Streamlit, SQLite, and NLP techniques to automate resume screening efficiently. Below are the detailed hardware and software requirements necessary for setting up and running the system.

3.2.1   Hardware Requirements:

Component	Minimum Requirement	Recommended Requirement
Processor (CPU)	Intel Core i3 (or equivalent)	Intel Core i5/i7
RAM	4GB	8GB or more
Storage	10 GB free disk space	20 GB free SSD storage
Network	Stable Internet	Stable Internet

- The system does not require a high-end GPU, as it uses TF-IDF and cousin similarity which are lightweight NLP techniques.
- However, if integrating deep learning models (eg. BERT), a GPU would be recommended

3.2.2   Software Requirements:

Category	Requirement
Operating System	Windows 10/11, macOS, Linux
Programming Language	Python 3.8+
Framework	Streamlit (for UI)
Database	SQLite (for storing job postings and resumes)
Python Libraries	math,sqlite3, streamlit, pandas, re, PyPDF2, sklearn

CHAPTER 4

Implementation and Result

4.1 Snap Shots of Result:

[Figure 3]

This snapshot represents the first load of the application where the job listing is created before any other user will apply for that job. We have to provide Job title and Job Description which contains the skills, experience and other job requirements on which the resume will be scored upon.

[Figure 4]

After the job has been posted a user can upload multiple resumes in the PDF format. The resumes will be scored on the bases of the job they are applying for. For example in the above snapshot we will apply for the job of Senior Python Developer. We can drag and drop multiple PDF in the drop-off zone the files will be processed in the background and the scores will be shown on the dashboard.
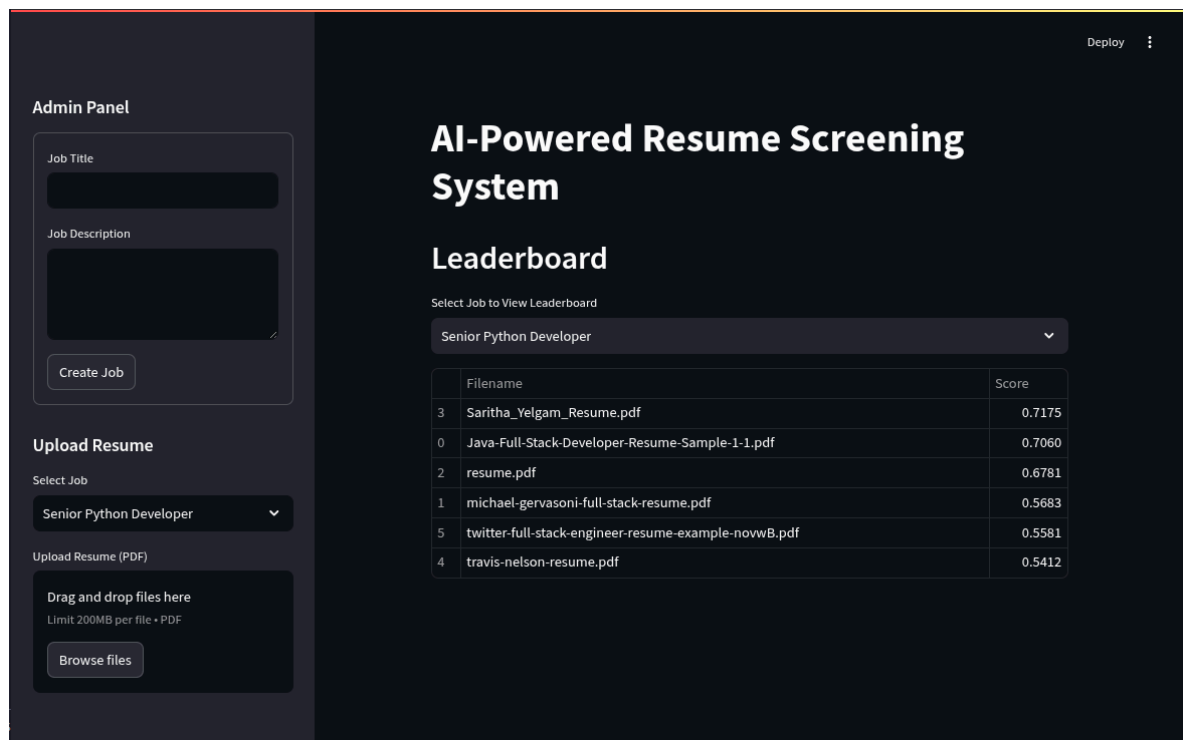
[Figure 5]

The scores are persistent meaning the scores for each resumes are stored in the databases.

GitHub Link for Code:

https://github.com/vedantjain8/AI-powered-Resume-Screening-and-Ranking-System

CHAPTER 5
Discussion and Conclusion

5.1   Future Work:

The AI-Powered Resume Screening and Ranking System has successfully automated the resume evaluation process using NLP techniques and AI-based ranking. However, several enhancements and improvements can be made to further refine the system and increase its efficiency. Below are some suggested future works:

Integration of Advanced NLP Models:

The current system relies on TF-IDF and cosine similarity for resume ranking. Future versions could integrate advanced deep learning models such as BERT (Bidirectional Encoder Representations from Transformers) or spaCy for better semantic understanding of resume content.

Improved Resume Parsing:

The resume extraction process could be enhanced using dedicated resume parsing libraries like spaCy's Named Entity Recognition (NER) or OpenAI's GPT-based models to better identify and categorize resume sections such as skills, education, and experience.

Multi-Language Support:

The existing system only processes resumes written in English. Future updates could introduce multi-language support by incorporating language detection and translation models, allowing the system to process resumes in various languages.

Bias Reduction in Resume Screening:

AI-driven hiring systems can sometimes introduce bias due to limitations in training data. Implementing fairness-aware AI techniques and using explainable AI (XAI) approaches can help mitigate biases and ensure ethical AI-based hiring.

Integration with Applicant Tracking Systems (ATS):

The system could be integrated with existing HR software and ATS platforms, such as Workday or Greenhouse, to enable seamless resume screening within enterprise hiring workflows.

Enhancing the UI/UX Experience:

The Streamlit-based UI could be expanded with interactive visualizations, drag-and-drop resume uploads, and real-time feedback on resume quality to improve the user experience for both candidates and recruiters.

Cloud Deployment and Scalability:

Deploying the system on cloud platforms like AWS, Google Cloud, or Heroku can improve scalability and enable multi-user access. Implementing serverless architectures could further enhance performance and cost efficiency.

Real-Time Candidate Feedback:

Future versions could include a resume improvement suggestion feature, where candidates receive real-time feedback based on AI analysis, helping them tailor their resumes for specific job postings.

Support for Additional File Formats:

Currently, the system processes only PDF files. Expanding support to DOCX, TXT, and HTML formats would increase its applicability and usability across different recruitment platforms.

Machine Learning-Based Job Matching:

Implementing classification algorithms and recommendation systems could allow the system to automatically suggest the best job postings for a given resume, further streamlining the hiring process.

5.2   Conclusion:

The AI-Powered Resume Screening and Ranking System effectively automates the resume evaluation process, significantly improving efficiency and accuracy in candidate shortlisting. By leveraging Natural Language Processing (NLP) techniques such as TF-IDF vectorization and cosine similarity, the system ranks resumes based on their relevance to a given job description, reducing the manual effort required in traditional hiring processes.

The project's key contributions include:

Automated Resume Screening: Extracting and analyzing key resume sections such as skills, experience, and education.

AI-Based Ranking System: Ensuring fair and data-driven candidate shortlisting using NLP-based similarity scoring.

Dynamic Skill Weighting: Prioritizing resumes containing job-specific skills, improving ranking accuracy.

User-Friendly and Scalable Design: Providing an intuitive Streamlit-based UI and efficient SQLite database management.

This project demonstrates the practical application of AI in human resource technology, showcasing how data-driven decision-making can enhance the recruitment process. The system bridges the gap between manual resume evaluation and AI-assisted hiring, offering recruiters an objective, scalable, and time-efficient solution.

While the system effectively addresses key challenges in resume screening, future enhancements—such as deep learning integration, multi-language support, and real-time candidate feedback—can further refine its capabilities. As organizations continue to embrace AI-driven recruitment, this project lays a strong foundation for future advancements in automated hiring solutions.

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