A Project Report

Submitted in partial fulfillment of the Requirements for the award of the Honors Degree of

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

Ai-Powered Resume analyzer

By,

Mr. Harsh Adsule

Under the esteemed guidance of,

Prof. Syama Krishna

MALAD KANDIVALI EDUCATION SOCIETY'S

DEPARTMENT OF COMPUTER SCIENCE OF

NAGINDAS KHANDWALA COLLEGE

(AUTONOMOUS)

(Reaccredited 'A' Grade by NAAC)
(AFFILIATED TO UNIVERSITY OF MUMBAI)
(ISO 9001:2015)

2023-2024

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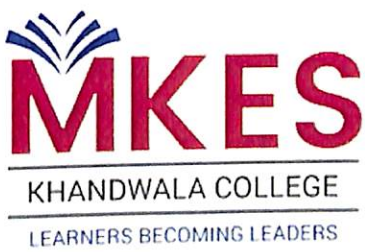

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MALAD KANDIVALI EDUCATION SOCIETY'S

NAGINDAS KHANDWALA COLLEGE OF COMMERCE, ARTS & MANAGEMENT STUDIES & SHANTABEN NAGINDAS KHANDWALA COLLEGE OF SCIENCE
MALAD [W], MUMBAI – 64

(AUTONOMOUS)

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(ISO 9001:2015)

CERTIFICATE

This is to certify that the project entitled, **'AI-Powered Resume analyzer'** is a bonafide work of **Mr. HARSH ADSULE** bearing roll no. **28** for the course, **Final Project (Course Code: 2365UHAIPR)** submitted in partial fulfillment of the requirements for the award of degree in **Bachelor of Science (Honors)** in (**Computer Science**. specialization **Artificial Intelligence and Machine Learning**) from University of Mumbai.

Internal Guide | **Coordinator** | **External Examiner**

Date: 01/04/2024

COLLEGE OF COMM., ARTS & MGMT & S.N.K. COLLEGE OF SCIENCE (AUTONOMOUS)
03 APR 2024
MALAD, MUMBAI

College Seal

Abstract

In today's highly competitive job market, having an impressive and well-crafted resume is crucial for job seekers to stand out and secure their desired employment opportunities. However, creating an effective resume can be a daunting task, especially for those with limited experience or knowledge of industry-specific requirements. This project presents an AI-powered resume analysis application that aims to address this challenge by providing users with personalized recommendations and insights to enhance their resumes.

The application leverages advanced natural language processing techniques and machine learning algorithms to extract relevant information from the user's uploaded resume in PDF format. It then performs a comprehensive analysis of the resume's content, including the candidate's basic information, skills, experience, and other pertinent details.

Based on the analysis, the application generates a detailed report highlighting the candidate's strengths and areas for improvement. It provides recommendations for additional skills to acquire, tailored to the user's career aspirations and the industry they are targeting. Furthermore, the application suggests relevant online courses and certifications to help users upskill and bridge any identified skill gaps.

To enhance the user experience, the application incorporates several features, such as resume scoring, bonus videos for resume writing and interview preparation tips, and interactive visualizations for admin-level data analysis. The application also integrates with a MySQL database to store and retrieve user data, enabling comprehensive reporting and analytics capabilities.

The project showcases the potential of AI and machine learning technologies in revolutionizing the resume analysis and job application process. By empowering users with personalized recommendations and actionable insights, the application aims to increase their chances of securing their desired job opportunities and unlocking their professional growth potential.

ACKNOWLEDGEMENT

I would like to place my sincere gratitude to those who have contributed to the successful completion of this project **"Ai-Powered Resume Analyzer"**

I wish to thank the principal of my college, **Ms. Moushumi Datta** and my respected **H.O.D Prof. Rashmi Tiwari** as well as the Management for their great support throughout my graduation years.

I take this opportunity to express my profound gratitude and deep regards to my guide **Prof. Syama Krishna** without whose guidance & critical appreciation, this project wouldhave been incomplete. Right from its inception, this project has been shaped by herexpert opinions and she has helped me improve this project in all manners and achieve the level that it has acquired.

DECLARATION

I hereby declare that the project entitled, **"Ai-Powered Resume analyzer "** done at **NAGINDAS KHANDWALA COLLEGE,** has not been in any case duplicated to submit to any other university for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university.

The project is done in partial fulfillment of the requirements for the award of degree of

BACHELOR OF SCIENCE (COMPUTER SCIENCE) to be submitted

as a final semester project as part of our curriculum.

Mr. Harsh Vinayak Adsule

Name and Signature of the Student

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CHAPTER 1: INTRODUCTION

In the contemporary job market, characterized by its highly competitive nature and the rapid e volution of professional skill sets, traditional methods of resume analysis and candidate evaluation often fall short of meeting the demands of employers and job seekers alike.

This gap has opened the door for more innovative, efficient, and effective solutions, heralding the arrival of AI-powered tools designed to transform the hiring process. The AI Resume Analyzer represents a leap forward in recruitment technology, combining the precision of artificial intelligence with the nuanced understanding of human resource practices.

This platform is not just another application in the recruitment space; it is a comprehensive solution aimed at optimizing resume analysis to match candidates with suitable job roles more accurately.

The AI Resume Analyzer is designed with several core modules, each aimed at enhancing the functionality and user experience of the platform. These include the resume parsing module, which extracts and interprets data from resumes; the skill analysis module, which evaluates the skills and competencies of candidates; the job matching module, which aligns candidates' profiles with suitable job vacancies; and the feedback and improvement module, which provides candidates with actionable insights to refine their resumes.

A standout feature of the platform is its deep learning algorithms, which not only automate the resume screening process but also continuously learn from recruitment outcomes to improve future matches.

BACKGROUND

The inception of the AI Resume Analyzer is rooted in the pressing need for innovation within the recruitment industry. As businesses and the job market continue to evolve at a breakneck pace, driven by technological advancements and changing economic landscapes, the traditional resume screening process has become increasingly inadequate.

This inadequacy is not just in terms of efficiency but also in the accuracy of matching candidates to job roles that align with their skills and career aspirations.

Traditional screening processes, often manual and time-consuming, are prone to human error and biases, leading to suboptimal job placements and missed opportunities for both employers and job seekers. Recognizing these challenges, the AI Resume Analyzer was developed to bridge the gap between the evolving job market's demands and the static nature of traditional recruitment methods.

The platform leverages cutting-edge artificial intelligence to automate and enhance the resume screening process, ensuring a more dynamic, precise, and unbiased approach to recruitment. By prioritizing customization, efficiency, and direct feedback, the AI Resume Analyzer aims to redefine the standards of recruitment, making it more aligned with the needs of the modern digital economy.

Its mission is to empower job seekers to present their credentials more effectively while enabling employers to identify and engage with the best talent swiftly and accurately. Through this innovative platform, the vision is to transform the recruitment landscape, making it more responsive, inclusive, and effective for all stakeholders involved.

OBJECTIVE

The primary objective of the AI Resume Analyzer is to redefine the recruitment process by providing an intelligent, efficient, and personalized job application experience. This platform aims to bridge the gap between job seekers and their potential employers through sophisticated AI-driven algorithms that accurately parse, analyze, and match resumes with suitable job openings. By leveraging a comprehensive database of job requirements and candidate profiles, the AI Resume Analyzer facilitates a seamless job matching process that aligns with the skills, experience, and career aspirations of candidates.

Key objectives include enhancing the resume screening process for recruiters, reducing hiring biases, and ensuring a fair and inclusive recruitment landscape. The platform also aims to provide job seekers with constructive feedback on their resumes, helping them to improve their presentation and increase their chances of securing interviews. Ultimately, the AI Resume Analyzer seeks to become the definitive tool for job matching, streamlining the recruitment process for all parties involved and setting a new standard for precision and effectiveness in the job market.

PURPOSE

The purpose of the AI Resume Analyzer is multifold. It seeks to revolutionize the way resumes are screened and processed by leveraging the power of artificial intelligence to provide a more accurate, fair, and efficient recruitment process. For employers, the purpose is to simplify the hiring process by offering tools that automatically filter candidates based on the job's requirements, thereby saving time and resources. For job seekers, it aims to democratize the job application process, offering insights into how their skills and experiences align with potential job opportunities and providing actionable feedback for resume improvement.

Furthermore, the platform intends to eliminate biases in the recruitment process, ensuring a more diverse and inclusive workforce. By automating the initial stages of the recruitment process, the AI Resume Analyzer also aims to enhance the candidate experience, making job search and application processes more responsive and user-friendly.

SCOPE

The scope of the AI Resume Analyzer encompasses a wide range of functionalities designed to streamline and enhance the recruitment process. The platform includes modules for resume parsing, skill analysis, job matching, and feedback generation, each equipped with advanced AI and machine learning algorithms to ensure high accuracy and relevance.

The AI Resume Analyzer is designed to cater to various stakeholders in the recruitment ecosystem, including HR departments, recruitment agencies, job boards, and job seekers themselves. Its application is intended for a broad spectrum of industries and job roles, making it a versatile tool for the modern job market.

The platform not only aims to match job seekers with suitable positions but also to provide valuable insights and analytics to employers, helping them understand the skills landscape and optimize their recruitment strategies. Through continuous learning and adaptation, the AI Resume Analyzer is poised to constantly evolve, reflecting changes in job market trends and requirements.

By encompassing these ambitious functionalities, the AI Resume Analyzer is set to transform the recruitment landscape, making it more efficient, fair, and aligned with the needs of both job seekers and employers in the digital age.

CHAPTER 2: Literature Review

2.1 : Gap Analysis

1. User Authentication and Authorization:

- The code lacks a proper user authentication and authorization system.

- Currently, there is a simple username and password check for the admin section, but it should be more secure and robust.

- Implementing a secure authentication system with features like password hashing, user roles, and permissions would enhance the application's security and allow for better user management.

2. Error Handling and Input Validation:

- The code does not have comprehensive error handling mechanisms in place.

- Input validation for user-provided data (e.g., uploaded resume files, form inputs) should be implemented to prevent potential security vulnerabilities and ensure data integrity.

3. Code Organization and Modularity:

- The code is contained within a single file, making it difficult to maintain and scale.

- Separating the code into different modules or classes based on functionality (e.g., database operations, file handling, recommendation logic) would improve code organization and maintainability.

4. Database Optimization and Indexing:

- The code does not include any database optimization techniques or indexing strategies.

- Indexing relevant columns in the database tables can significantly improve query performance, especially as the data grows larger.

5. Logging and Monitoring:

- The code lacks proper logging mechanisms to track application events, errors, and user activities.

- Implementing a logging system would aid in debugging, monitoring, and auditing the application's behavior.

6. Testing and Code Quality:

- There are no unit tests or integration tests included in the codebase.

- Implementing automated tests would ensure the code's correctness, reliability, and facilitate easier refactoring and maintenance.

- Code quality could be improved by adhering to best coding practices, such as following a consistent coding style and using appropriate variable and function names.

7. Documentation and Comments:

- The code lacks proper documentation and comments explaining the purpose, functionality, and usage of different components.

- Providing comprehensive documentation and code comments would aid in understanding and maintaining the codebase, especially for new developers or collaborators.

8. Scalability and Performance:

- The code does not consider scalability or performance optimizations.

- As the number of users and resumes increases, the application may face performance issues.

- Implementing caching mechanisms, load balancing, and other performance optimization techniques could improve the application's scalability and responsiveness.

9. User Experience and Feedback:

- The code does not include mechanisms for gathering user feedback or improving the user experience.

- Incorporating user feedback forms, rating systems, or surveys could help identify areas for improvement and enhance the overall user experience.

10. Additional Features:

- Depending on the project requirements, additional features or functionality might be needed, such as:

  - Resume parsing and analysis for multiple languages

  - Integration with job portals or job search engines

  - Personalized recommendation algorithms based on user preferences or job requirements

  - Collaborative filtering or content-based recommendation systems

  - Support for different resume formats (e.g., Word, plain text)

  - Integration with third-party services (e.g., email notifications, job alerts)

2.2 : Literature Review

1. Introduction

The resume analysis and recommendation system has gained significant attention in recent years due to the increasing volume of job applications and the need for efficient candidate screening processes. Several studies have explored the use of natural language processing (NLP) and machine learning techniques to automate resume parsing, skill extraction, and job recommendation tasks.

2. Resume Parsing and Information Extraction

One of the fundamental components of a resume analysis system is the ability to extract relevant information from resumes. Raza et al. (2021) proposed a deep learning-based approach for extracting structured information, such as personal details, education, and work experience, from resumes. Their approach leveraged a combination of Bidirectional Encoder Representations from Transformers (BERT) and Conditional Random Fields (CRF) models to achieve high accuracy in information extraction.

Similarly, Ratinov and Roth (2009) developed a system for extracting various fields from resumes, including education, experience, skills, and contact information, using conditional random fields and other machine learning techniques.

3. Skill Extraction and Recommendation

Extracting relevant skills from resumes is crucial for matching candidates with suitable job opportunities. Nguyen et al. (2022) proposed a skill extraction and recommendation system using natural language processing techniques and graph-based algorithms. Their approach involved constructing a skill graph based on job descriptions and resumes, and leveraging graph algorithms to recommend relevant skills to candidates.

Another study by Cheng et al. (2020) explored the use of deep learning models, such as convolutional neural networks (CNNs) and long short-term memory (LSTM) networks, for skill extraction from resumes. Their approach achieved high accuracy in identifying technical and non-technical skills.

4. Course Recommendation

In addition to skill recommendations, some resume analysis systems provide course recommendations to help candidates upskill or acquire new competencies. Sharma and Kaur (2021) developed a course recommendation system based on skill gaps identified from resume

analysis. Their system employed collaborative filtering techniques to recommend relevant courses based on the candidate's current skills and the skills required for their desired job roles.

5. User Experience and Visualization

Enhancing the user experience and providing intuitive visualizations is essential for effective resume analysis systems. Bhatnagar et al. (2020) developed a web-based resume analysis platform that leveraged natural language processing and data visualization techniques to provide a user-friendly interface for resume evaluation and skill gap analysis.

6. Challenges and Future Directions

Despite the advancements in resume analysis and recommendation systems, several challenges remain. One significant challenge is handling resumes in various formats and languages. Chaudhary et al. (2022) discussed the need for robust resume parsers that can handle diverse resume formats and languages to ensure accurate information extraction.

Another challenge is the continuous evolution of job requirements and skills. As new technologies and job roles emerge, resume analysis systems must adapt and incorporate mechanisms for updating their knowledge bases and recommendation algorithms.

Future research directions may include exploring more advanced natural language processing techniques, such as transformer-based models and few-shot learning, for improved resume parsing and skill extraction. Additionally, incorporating feedback mechanisms and user-centric design principles can enhance the user experience and ensure that the recommendations align with individual preferences and career goals.

7. Conclusion

The literature review highlights the ongoing research efforts in developing effective resume analysis and recommendation systems. While significant progress has been made in areas such as resume parsing, skill extraction, and course recommendations, challenges remain in terms of handling diverse resume formats, adapting to evolving job requirements, and enhancing user experiences. Continued research and development in this field can contribute to more efficient and personalized career guidance and job matching processes.

CHAPTER 3: REQUIREMENT & ANALYSIS

PROBLEM DEFINITION

The primary challenge addressed by this AI Resume Analyzer is the inefficiency and inaccuracy in the traditional resume screening process. Both job seekers and recruiters face difficulties due to the manual, time-consuming task of matching skills and experiences with job requirements. This system proposes an automated, intelligent solution to streamline resume analysis, enhance match accuracy, and improve the recruitment process by leveraging natural language processing, machine learning, and direct feedback mechanisms.

DRAWBACK OF EXSISTING SYSTEMS

1. Time-consuming Process: Manual screening of resumes is extremely time-consuming, especially for roles attracting hundreds or thousands of applications.

2. Inaccuracy and Bias: Human reviewers can inadvertently introduce biases, leading to potentially unfair screening outcomes. Furthermore, manual processes are prone to errors, potentially overlooking qualified candidates.

3. Scalability Issues: As the number of applicants increases, the existing manual system becomes less viable, unable to scale efficiently to meet the demands of larger applicant pools.

4. Lack of Personalization: Existing systems often fail to tailor the job search and application experience to individual candidates, missing opportunities to match applicants with roles that suit their unique skill sets and career aspirations.

5. Inadequate Feedback Mechanism: Candidates rarely receive detailed feedback on their applications, leaving them in the dark about their application's strengths and weaknesses.

6. Limited Integration: Existing systems often operate in isolation without integrating with other HR tools and systems, leading to fragmented processes and inefficiencies.

7. Difficulty in Identifying Soft Skills: Manual systems struggle to accurately assess and match soft skills, which are increasingly important in modern job markets.

8. Dependency on Keyword Matching: Traditional systems heavily rely on keyword matching, which can be easily manipulated by candidates and does not necessarily reflect their true qualifications or potential.

9. Overlooked Potential: Manual screening may not fully recognize the potential of candidates who are transitioning between fields, have non-linear career paths, or possess transferable skills that are not directly stated in their resumes.

List of Technologies

1. Natural Language Processing (NLP) Libraries

NLTK (Natural Language Toolkit): An essential library for working with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources, such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning.

SpaCy: A modern, fast, and industrial-strength natural language processing library. You specifically used SpaCy version 2.3.5 and its English model en_core_web_sm-2.3.1. SpaCy is designed for production use and provides an excellent balance between speed, accuracy, and the amount of data it can handle.

2. Resume Parsing

Pyresparser: Utilized for extracting information from resumes in a variety of formats. It leverages NLP libraries like NLTK and SpaCy for parsing and extracting structured information from text documents, making it a key component in analyzing resumes and extracting essential data such as skills, education, and work experience.

3. PDF Processing

PDFMiner3: A tool for extracting information from PDF documents. You've used it to read and convert PDF content into text, which is then processed by your application. PDFMiner3 is essential for parsing resumes in PDF format, allowing the extraction of text for further analysis.

4. Web Application Framework

Streamlit: A fast and simple way to create web applications for machine learning and data science projects. It's used here to build the user interface of your AI Resume Analyzer, enabling users to upload resumes, view analyses, and interact with the system through a web browser.

5. Database Connection

PyMySQL: A pure-Python MySQL client library, used in this project to connect to and interact with a MySQL database. This database stores user data, resume analysis results, and other relevant information, making PyMySQL crucial for data persistence and retrieval.

6. Data Analysis and Visualization

Pandas: A fast, powerful, flexible, and easy-to-use open-source data analysis and manipulation tool, built on top of the Python programming language. It's used for managing and analyzing data extracted from resumes.

Plotly Express: A high-level Python visualization library. It's used here for creating dynamic visualizations that can help administrators understand trends and distributions in the data, such as the fields users are interested in or the level of experience of job seekers.

7. Video Content

Pafy: A Python library to download YouTube content and retrieve metadata. In your project, it's used to fetch and display YouTube videos related to resume writing and interview preparation, providing additional resources to the user.

8. Utility and Miscellaneous

Base64, Random, Time, Datetime, IO: These standard Python libraries are used for various utility functions such as encoding, time operations, and file handling, ensuring smooth operation of the application.

This comprehensive use of diverse technologies from NLP for text analysis, PDF processing for document handling, to web frameworks for user interaction, highlights the multifaceted approach of your AI Resume Analyzer in automating and enhancing the resume review process.

Miscellaneous Technologies

Base64: Utilized for encoding binary files (like PDFs) into text strings that can be embedded or transported easily within your application.

Pandas: Offers data manipulation and analysis capabilities, crucial for handling the structured data obtained from resume parsing.

Python's Standard Libraries (random, time, datetime, io): Provide support for various utility functions such as file handling, generating timestamps, and managing random operations within your application.

Comparative Technologies Not Directly Used but Relevant

HTML & CSS: Fundamental technologies for creating and styling web pages, which could be utilized alongside JavaScript for enhancing the frontend of the web application.

PHP & SQL: Server-side scripting and database management languages that could serve as alternatives or supplements to your current backend and database management system.

This survey of technologies demonstrates a comprehensive integration of NLP, web development, database management, and data visualization tools, collectively enabling the AI Resume Analyzer to efficiently process, analyze, and present resume data.

Feasibility Study

Technical Feasibility: The use of technologies like Python, NLTK for natural language processing, Spacy for text analysis, Streamlit for web application development, and MySQL for database management, is well-documented and supported. The integration of these technologies for parsing resumes, analyzing content, and recommending jobs is technically feasible with the right expertise.

Economic Feasibility: The development costs primarily include software development resources, cloud hosting fees, and any costs associated with accessing third-party APIs or tools. The use of open-source technologies like Python, NLTK, and Spacy can significantly reduce software costs. A subscription-based model or premium features could generate revenue to cover these costs.

Market Feasibility: There is a growing demand for AI-based tools that streamline job search and recruitment processes by providing more personalized and accurate recommendations. The system's success depends on its ability to offer significant value over traditional job boards and resume services through better matching and insights.

Operational Feasibility: The system requires ongoing maintenance for the database, user support, and continuous improvement of the AI algorithms to adapt to new resume formats and job market trends. The operational aspects are feasible with a dedicated team for development, support, and marketing.

Legal and Ethical Feasibility: Compliance with data protection regulations (such as GDPR in Europe) is crucial, especially for handling personal information in resumes. The system must include robust security measures to protect user data and transparent privacy policies.

Requirement Gathering:

Functional Requirements:

1. User Registration and Authentication:
    - Users can register and log in to access their profiles and the system's features.
    - Password encryption and secure authentication mechanisms.
2. Resume Upload and Parsing:
    - Users can upload their resumes in PDF format.
    - The system parses uploaded resumes using the Pyresparser library to extract key information, including personal details, skills, experiences, and education.
3. Skills Tagging and Editing:
    - Extracted skills are displayed to users as tags that can be edited or added manually.
    - Use of NLTK and Spacy for natural language processing to identify and categorize skills.
4. Job Recommendation:
    - Based on the parsed resume and skills, the system recommends jobs using predefined criteria matching user skills with job requirements.
    - Recommendations are dynamically updated based on new job postings and user profile updates.
5. Courses and Learning Material Recommendation:
    - Recommends online courses and learning materials relevant to enhancing the user's skills and career objectives.
    - Integration with third-party educational platforms for course data.
6. Resume and Interview Preparation Assistance:
    - Provides tips for resume improvement and links to resources for interview preparation.
    - Embedding YouTube videos or other resources for resume writing and interview
    - skills enhancement.

Non-Functional Requirements:

1. Performance:
    - Fast and responsive user interface, with resume parsing and job recommendations generated within a few seconds.
2. Scalability:
    - System architecture supports scaling to accommodate a growing number of users and job postings.
3. Security:
    - User data, including personal information and resume content, is encrypted and stored securely.
    - Compliance with data protection regulations (e.g., GDPR).
4. Usability:
    - Intuitive user interface with clear navigation and instructions for users.
    - Mobile-responsive design to ensure accessibility on various devices.
5. Reliability:
    - Regular backups of user data and system databases.
    - Error handling mechanisms to ensure the system remains operational with minimal downtime.
6. Integration:
    - Integration capabilities with job boards and educational platforms for job and course recommendations.
    - API endpoints for extending functionality or incorporating the system into existing platforms.

Planning and scheduling

December - Project Initiation and Setup

1. Week 1: Project Kickoff

- Form project team.

- Define project scope and objectives.

- Initial project documentation.

2. Week 2: Environment Setup

- Install required libraries and tools (`nltk`, `spacy`, `pyresparser`, etc.).

- Setup development environment (IDE, version control, etc.).

3. Week 3-4: System Design and Architecture

- Design system architecture.

- Define database schema and setup SQL database.

- Initial UI/UX design for the application.

January - Development Phase 1

1. Week 1-2: Core Development

- Implement resume upload and PDF parsing functionality.

- Develop the skills extraction and tagging system.

2. Week 3-4: Job and Course Recommendation Logic

- Implement job recommendation logic based on extracted skills.

- Integrate courses and learning material recommendations.

February - Development Phase 2 and Testing

1. Week 1-2: User Interface and Experience

- Develop and refine the application's user interface based on initial designs.

- Implement user registration, authentication, and profile management.

2. Week 3: System Integration and Testing

- Integrate different system components (backend logic, database, frontend UI).

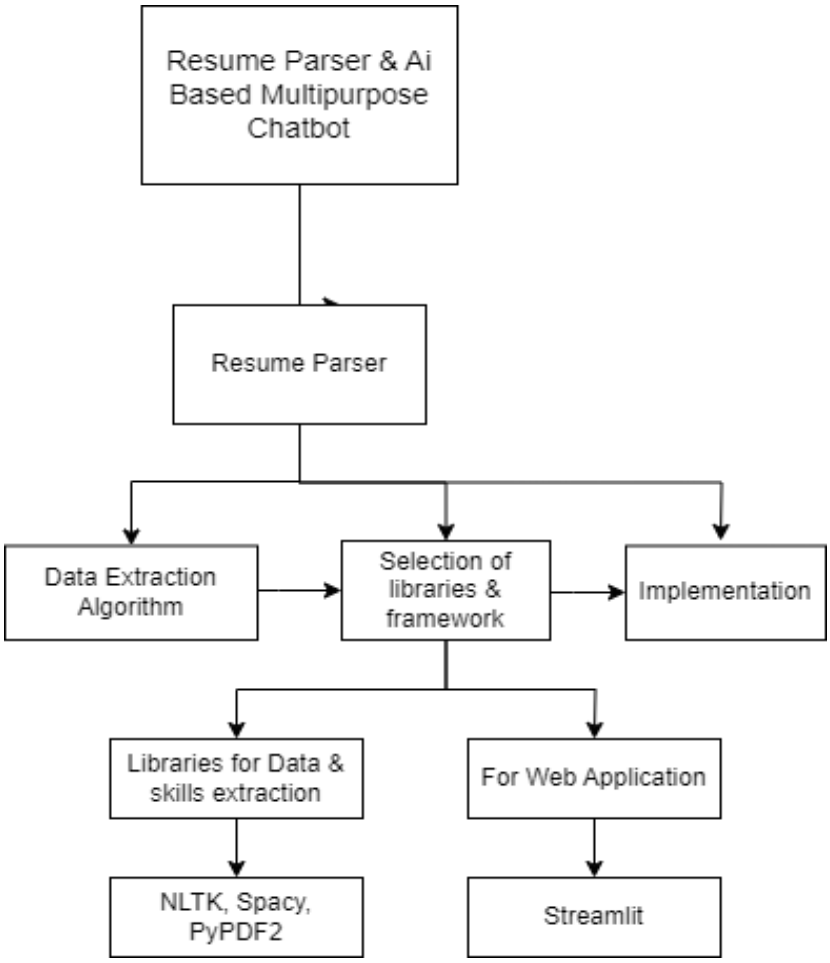
- Conduct initial system testing and bug fixing.

3. Week 4: User Acceptance Testing (UAT)
   - Deploy the application for a testing phase with selected users.
   - Collect feedback and make necessary adjustments.

March - Finalization and Deployment

1. Week 1-2: Final Testing and Refinement
   - Perform final testing including load testing and security assessments.
   - Refine the application based on feedback and test results.
2. Week 3: Deployment
   - Prepare production environment.
   - Deploy application and monitor for issues.
3. Week 4: Project Closure
   - Final documentation and project review.
   - Plan for future maintenance and potential feature updates.

SYSTEM FLOW CHART



CHAPTER 4: Code & Implementation

4.1 : Code

```
#SET UP:

# 1. INSTALL BELOW LIBRARIES

        #pip install -r requirements.txt

        # pip install nltk

        # pip install spacy==2.3.5

        # pip install https://github.com/explosion/spacy-
models/releases/download/en_core_web_sm-2.3.1/en_core_web_sm-2.3.1.tar.gz

        # pip install pyresparser

# 2. CREAT A FOLDER AND NAME IT (e.g. resume)
        #2.1 create two more folders inside this folder (Logo and
Uploaded_Resumes)
        #2.2 create two python files (App.py and Courses.py)

# 3. START YOUR SQL DATABASE


# 4. CONTINUE WITH THE FOLLOWING CODE...

import streamlit as st
import pandas as pd
import base64,random
import time,datetime
#libraries to parse the resume pdf files
from pyresparser import ResumeParser
from pdfminer3.layout import LAParams, LTTextBox
from pdfminer3.pdfpage import PDFPage
from pdfminer3.pdfinterp import PDFResourceManager
from pdfminer3.pdfinterp import PDFPageInterpreter
from pdfminer3.converter import TextConverter
import io,random
from streamlit_tags import st_tags
from PIL import Image
import pymysql
```

```
from Courses import
ds_course,web_course,android_course,ios_course,uiux_course,resume_videos,intervie
w_videos
import pafy #for uploading youtube videos
import plotly.express as px #to create visualisations at the admin session
import nltk
nltk.download('stopwords')


def fetch_yt_video(link):
    video = pafy.new(link)
    return video.title

def get_table_download_link(df,filename,text):
    """Generates a link allowing the data in a given panda dataframe to be
downloaded
    in: dataframe
    out: href string
    """
    csv = df.to_csv(index=False)
    b64 = base64.b64encode(csv.encode()).decode() # some strings <-> bytes
conversions necessary here
    # href = f'<a href="data:file/csv;base64,{b64}">Download Report</a>'
    href = f'<a href="data:file/csv;base64,{b64}"
download="{filename}">{text}</a>'
    return href

def pdf_reader(file):
    resource_manager = PDFResourceManager()
    fake_file_handle = io.StringIO()
    converter = TextConverter(resource_manager, fake_file_handle,
laparams=LAParams())
    page_interpreter = PDFPageInterpreter(resource_manager, converter)
    with open(file, 'rb') as fh:
        for page in PDFPage.get_pages(fh,
                                      caching=True,
                                      check_extractable=True):
            page_interpreter.process_page(page)
            print(page)
        text = fake_file_handle.getvalue()

    # close open handles
    converter.close()
    fake_file_handle.close()
    return text
```

```
def show_pdf(file_path):
    with open(file_path, "rb") as f:
        base64_pdf = base64.b64encode(f.read()).decode('utf-8')
    # pdf_display = f'<embed src="data:application/pdf;base64,{base64_pdf}"
width="700" height="1000" type="application/pdf">'
    pdf_display = F'<iframe src="data:application/pdf;base64,{base64_pdf}"
width="700" height="1000" type="application/pdf"></iframe>'
    st.markdown(pdf_display, unsafe_allow_html=True)

def course_recommender(course_list):
    st.subheader("**Courses & Certificates Recommendations 🎓🎓**")
    c = 0
    rec_course = []
    no_of_reco = st.slider('Choose Number of Course Recommendations:', 1, 10, 5)
    random.shuffle(course_list)
    for c_name, c_link in course_list:
        c += 1
        st.markdown(f"({c}) [{c_name}]({c_link})")
        rec_course.append(c_name)
        if c == no_of_reco:
            break
    return rec_course


#CONNECT TO DATABASE

connection =
pymysql.connect(host='localhost',port=3306,user='root',password='1234'.encode('ut
f-8'),db='cv')
cursor = connection.cursor()

def
insert_data(name,email,res_score,timestamp,no_of_pages,reco_field,cand_level,skil
ls,recommended_skills,courses):
    DB_table_name = 'user_data'
    insert_sql = "insert into " + DB_table_name + """
    values (0,%s,%s,%s,%s,%s,%s,%s,%s,%s,%s)"""
    rec_values = (name, email, str(res_score), timestamp,str(no_of_pages),
reco_field, cand_level, skills,recommended_skills,courses)
    cursor.execute(insert_sql, rec_values)
    connection.commit()

st.set_page_config(
   page_title="AI Resume Analyzer",
   page_icon='./Logo/logo2.png',
)
```

```
def run():
    img = Image.open('./Logo/logo2.png')
    # img = img.resize((250,250))
    st.image(img)
    st.title("AI Resume Analyser")
    st.sidebar.markdown("# Choose User")
    activities = ["User", "Admin"]
    choice = st.sidebar.selectbox("Choose among the given options:", activities)
    link = '[©Developed by ,Harsh](http://www.linkedin.com/in/harsh-adsule-
r2787)'
    st.sidebar.markdown(link, unsafe_allow_html=True)


    # Create the DB
    db_sql = """CREATE DATABASE IF NOT EXISTS CV;"""
    cursor.execute(db_sql)

    # Create table
    DB_table_name = 'user_data'
    table_sql = "CREATE TABLE IF NOT EXISTS " + DB_table_name + """
                    (ID INT NOT NULL AUTO_INCREMENT,
                     Name varchar(500) NOT NULL,
                     Email_ID VARCHAR(500) NOT NULL,
                     resume_score VARCHAR(8) NOT NULL,
                     Timestamp VARCHAR(50) NOT NULL,
                     Page_no VARCHAR(5) NOT NULL,
                     Predicted_Field BLOB NOT NULL,
                     User_level BLOB NOT NULL,
                     Actual_skills BLOB NOT NULL,
                     Recommended_skills BLOB NOT NULL,
                     Recommended_courses BLOB NOT NULL,
                     PRIMARY KEY (ID));
                    """
    cursor.execute(table_sql)
    if choice == 'User':
        st.markdown('''<h5 style='text-align: left; color: #021659;'> Upload your
resume to get key points for faster analysis</h5>''',
                    unsafe_allow_html=True)
        pdf_file = st.file_uploader("Choose your Resume", type=["pdf"])
        if pdf_file is not None:
            with st.spinner('Uploading your Resume...'):
                time.sleep(4)
            save_image_path = './Uploaded_Resumes/'+pdf_file.name
            with open(save_image_path, "wb") as f:
                f.write(pdf_file.getbuffer())
            show_pdf(save_image_path)
```

```
            resume_data = ResumeParser(save_image_path).get_extracted_data()
            if resume_data:
                ## Get the whole resume data
                resume_text = pdf_reader(save_image_path)

                st.header("**Resume Analysis**")
                st.success("Hello "+ resume_data['name'])
                st.subheader("**Your Basic info**")
                try:
                    st.text('Name: '+resume_data['name'])
                    st.text('Email: ' + resume_data['email'])
                    st.text('Contact: ' + resume_data['mobile_number'])
                    st.text('Resume pages: '+str(resume_data['no_of_pages']))
                except:
                    pass
                cand_level = ''
                if resume_data['no_of_pages'] == 1:
                    cand_level = "Fresher"
                    st.markdown( '''<h4 style='text-align: left; color:
#d73b5c;'>You are at Fresher level!</h4>''',unsafe_allow_html=True)
                elif resume_data['no_of_pages'] == 2:
                    cand_level = "Intermediate"
                    st.markdown('''<h4 style='text-align: left; color:
#1ed760;'>You are at intermediate level!</h4>''',unsafe_allow_html=True)
                elif resume_data['no_of_pages'] >=3:
                    cand_level = "Experienced"
                    st.markdown('''<h4 style='text-align: left; color:
#fba171;'>You are at experience level!''',unsafe_allow_html=True)

                # st.subheader("**Skills Recommendation💡💡**")
                ## Skill shows
                keywords = st_tags(label='### Your Current Skills',
                text='See our skills recommendation below',
                    value=resume_data['skills'],key = '1  ')

                ##  keywords
                ds_keyword = ['tensorflow','keras','pytorch','machine
learning','deep Learning','flask','streamlit']
                web_keyword = ['react', 'django', 'node jS', 'react js', 'php',
'laravel', 'magento', 'wordpress',
                               'javascript', 'angular js', 'c#', 'flask']
                android_keyword = ['android','android
development','flutter','kotlin','xml','kivy']
                ios_keyword = ['ios','ios development','swift','cocoa','cocoa
touch','xcode']
```

```
                uiux_keyword = ['ux','adobe
xd','figma','zeplin','balsamiq','ui','prototyping','wireframes','storyframes','ad
obe photoshop','photoshop','editing','adobe illustrator','illustrator','adobe
after effects','after effects','adobe premier pro','premier pro','adobe
indesign','indesign','wireframe','solid','grasp','user research','user
experience']

                recommended_skills = []
                reco_field = ''
                rec_course = ''
                ## Courses recommendation
                for i in resume_data['skills']:
                    ## Data science recommendation
                    if i.lower() in ds_keyword:
                        print(i.lower())
                        reco_field = 'Data Science'
                        st.success("** Our analysis says you are looking for Data
Science Jobs.**")
                        recommended_skills = ['Data Visualization','Predictive
Analysis','Statistical Modeling','Data Mining','Clustering &
Classification','Data Analytics','Quantitative Analysis','Web Scraping','ML
Algorithms','Keras','Pytorch','Probability','Scikit-
learn','Tensorflow',"Flask",'Streamlit']
                        recommended_keywords = st_tags(label='### Recommended
skills for you.',
                        text='Recommended skills generated from
System',value=recommended_skills,key = '2')
                        st.markdown('''<h4 style='text-align: left; color:
#1ed760;'>Adding this skills to resume will boost🚀🚀 the chances of getting a
Job</h4>''',unsafe_allow_html=True)
                        rec_course = course_recommender(ds_course)
                        break

                    ## Web development recommendation
                    elif i.lower() in web_keyword:
                        print(i.lower())
                        reco_field = 'Web Development'
                        st.success("** Our analysis says you are looking for Web
Development Jobs **")
                        recommended_skills = ['React','Django','Node JS','React
JS','php','laravel','Magento','wordpress','Javascript','Angular
JS','c#','Flask','SDK']
                        recommended_keywords = st_tags(label='### Recommended
skills for you.',
                        text='Recommended skills generated from
System',value=recommended_skills,key = '3')
```

```
                        st.markdown('''<h4 style='text-align: left; color:
#1ed760;'>Adding this skills to resume will boost🚀🚀 the chances of getting a
Job💼💼</h4>''',unsafe_allow_html=True)
                        rec_course = course_recommender(web_course)
                        break

                    ## Android App Development
                    elif i.lower() in android_keyword:
                        print(i.lower())
                        reco_field = 'Android Development'
                        st.success("** Our analysis says you are looking for
Android App Development Jobs **")
                        recommended_skills = ['Android','Android
development','Flutter','Kotlin','XML','Java','Kivy','GIT','SDK','SQLite']
                        recommended_keywords = st_tags(label='### Recommended
skills for you.',
                        text='Recommended skills generated from
System',value=recommended_skills,key = '4')
                        st.markdown('''<h4 style='text-align: left; color:
#1ed760;'>Adding this skills to resume will boost🚀🚀 the chances of getting a
Job💼💼</h4>''',unsafe_allow_html=True)
                        rec_course = course_recommender(android_course)
                        break

                    ## IOS App Development
                    elif i.lower() in ios_keyword:
                        print(i.lower())
                        reco_field = 'IOS Development'
                        st.success("** Our analysis says you are looking for IOS
App Development Jobs **")
                        recommended_skills = ['IOS','IOS
Development','Swift','Cocoa','Cocoa Touch','Xcode','Objective-
C','SQLite','Plist','StoreKit',"UI-Kit",'AV Foundation','Auto-Layout']
                        recommended_keywords = st_tags(label='### Recommended
skills for you.',
                        text='Recommended skills generated from
System',value=recommended_skills,key = '5')
                        st.markdown('''<h4 style='text-align: left; color:
#1ed760;'>Adding this skills to resume will boost🚀🚀 the chances of getting a
Job💼💼</h4>''',unsafe_allow_html=True)
                        rec_course = course_recommender(ios_course)
                        break

                    ## Ui-UX Recommendation
                    elif i.lower() in uiux_keyword:
                        print(i.lower())
```

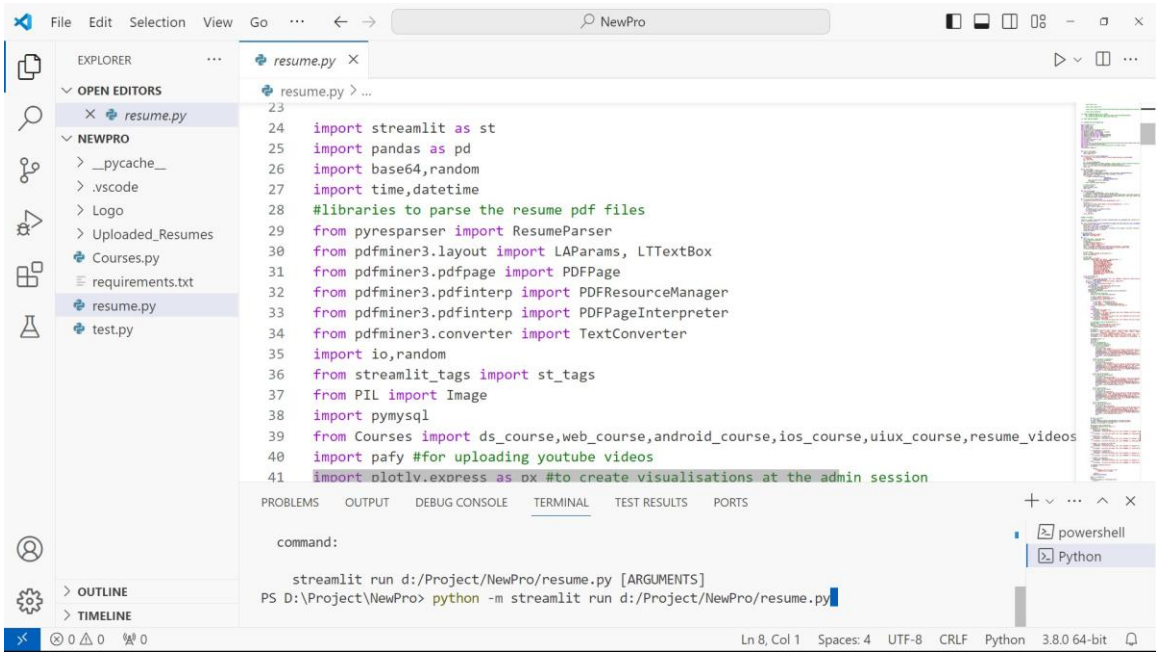
```
                        reco_field = 'UI-UX Development'
                        st.success("** Our analysis says you are looking for UI-
UX Development Jobs **")
                        recommended_skills = ['UI','User Experience','Adobe
XD','Figma','Zeplin','Balsamiq','Prototyping','Wireframes','Storyframes','Adobe
Photoshop','Editing','Illustrator','After Effects','Premier
Pro','Indesign','Wireframe','Solid','Grasp','User Research']
                        recommended_keywords = st_tags(label='### Recommended
skills for you.',
                        text='Recommended skills generated from
System',value=recommended_skills,key = '6')
                        st.markdown('''<h4 style='text-align: left; color:
#1ed760;'>Adding this skills to resume will boost🚀🚀 the chances of getting a
Job💼💼</h4>''',unsafe_allow_html=True)
                        rec_course = course_recommender(uiux_course)
                        break


                ## Insert into table
                ts = time.time()
                cur_date = datetime.datetime.fromtimestamp(ts).strftime('%Y-%m-
%d')
                cur_time =
datetime.datetime.fromtimestamp(ts).strftime('%H:%M:%S')
                timestamp = str(cur_date+'_'+cur_time)

                ### Resume writing recommendation
                st.subheader("**Resume Tips & Ideas💡💡**")
                resume_score = 0
                if 'Objective' in resume_text:
                    resume_score = resume_score+20
                    st.markdown('''<h5 style='text-align: left; color:
#1ed760;'>[+] Awesome! You have added Objective</h4>''',unsafe_allow_html=True)
                else:
                    st.markdown('''<h5 style='text-align: left; color:
#000000;'>[-] Please add your career objective, it will give your career
intension to the Recruiters.</h4>''',unsafe_allow_html=True)

                if 'Declaration' in resume_text:
                    resume_score = resume_score + 20
                    st.markdown('''<h5 style='text-align: left; color:
#1ed760;'>[+] Awesome! You have added Delcaration/h4>''',unsafe_allow_html=True)
                else:
                    st.markdown('''<h5 style='text-align: left; color:
#000000;'>[-] Please add Declaration. It will give the assurance that everything
```

```
written on your resume is true and fully acknowledged by
you</h4>''',unsafe_allow_html=True)

                if 'Hobbies' or 'Interests'in resume_text:
                    resume_score = resume_score + 20
                    st.markdown('''<h5 style='text-align: left; color:
#1ed760;'>[+] Awesome! You have added your
Hobbies</h4>''',unsafe_allow_html=True)
                else:
                    st.markdown('''<h5 style='text-align: left; color:
#000000;'>[-] Please add Hobbies. It will show your persnality to the Recruiters
and give the assurance that you are fit for this role or
not.</h4>''',unsafe_allow_html=True)

                if 'Achievements' in resume_text:
                    resume_score = resume_score + 20
                    st.markdown('''<h5 style='text-align: left; color:
#1ed760;'>[+] Awesome! You have added your Achievements
</h4>''',unsafe_allow_html=True)
                else:
                    st.markdown('''<h5 style='text-align: left; color:
#000000;'>[-] Please add Achievements. It will show that you are capable for the
required position.</h4>''',unsafe_allow_html=True)

                if 'Projects' in resume_text:
                    resume_score = resume_score + 20
                    st.markdown('''<h5 style='text-align: left; color:
#1ed760;'>[+] Awesome! You have added your
Projects</h4>''',unsafe_allow_html=True)
                else:
                    st.markdown('''<h5 style='text-align: left; color:
#000000;'>[-] Please add Projects. It will show that you have done work related
the required position or not.</h4>''',unsafe_allow_html=True)

                st.subheader("**Resume Score📝📝**")
                st.markdown(
                    """
                    <style>
                        .stProgress > div > div > div > div {
                            background-color: #d73b5c;
                        }
                    </style>""",
                    unsafe_allow_html=True,
                )
                my_bar = st.progress(0)
                score = 0
```

```
                for percent_complete in range(resume_score):
                    score +=1
                    time.sleep(0.1)
                    my_bar.progress(percent_complete + 1)
                st.success('** Your Resume Writing Score: ' + str(score)+'**')
                st.warning("** Note: This score is calculated based on the
content that you have in your Resume. **")
                st.balloons()

                insert_data(resume_data['name'], resume_data['email'],
str(resume_score), timestamp,
                            str(resume_data['no_of_pages']), reco_field,
cand_level, str(resume_data['skills']),
                            str(recommended_skills), str(rec_course))


                ## Resume writing video
                st.header("**Bonus Video for Resume Writing Tips💡💡**")
                resume_vid = random.choice(resume_videos)
                res_vid_title = fetch_yt_video(resume_vid)
                st.subheader("✅ **"+res_vid_title+"**")
                st.video(resume_vid)



                ## Interview Preparation Video
                st.header("**Bonus Video for Interview Tips💡💡**")
                interview_vid = random.choice(interview_videos)
                int_vid_title = fetch_yt_video(interview_vid)
                st.subheader("✅ **" + int_vid_title + "**")
                st.video(interview_vid)

                connection.commit()
            else:
                st.error('Something went wrong..')
    else:
        ## Admin Side
        st.success('Welcome to Admin Side')
        # st.sidebar.subheader('**ID / Password Required!**')

        ad_user = st.text_input("Username")
        ad_password = st.text_input("Password", type='password')
        if st.button('Login'):
            if ad_user == 'Harsh25' and ad_password == '12345678':
                st.success("Welcome Dr Briit !")
                # Display Data
```

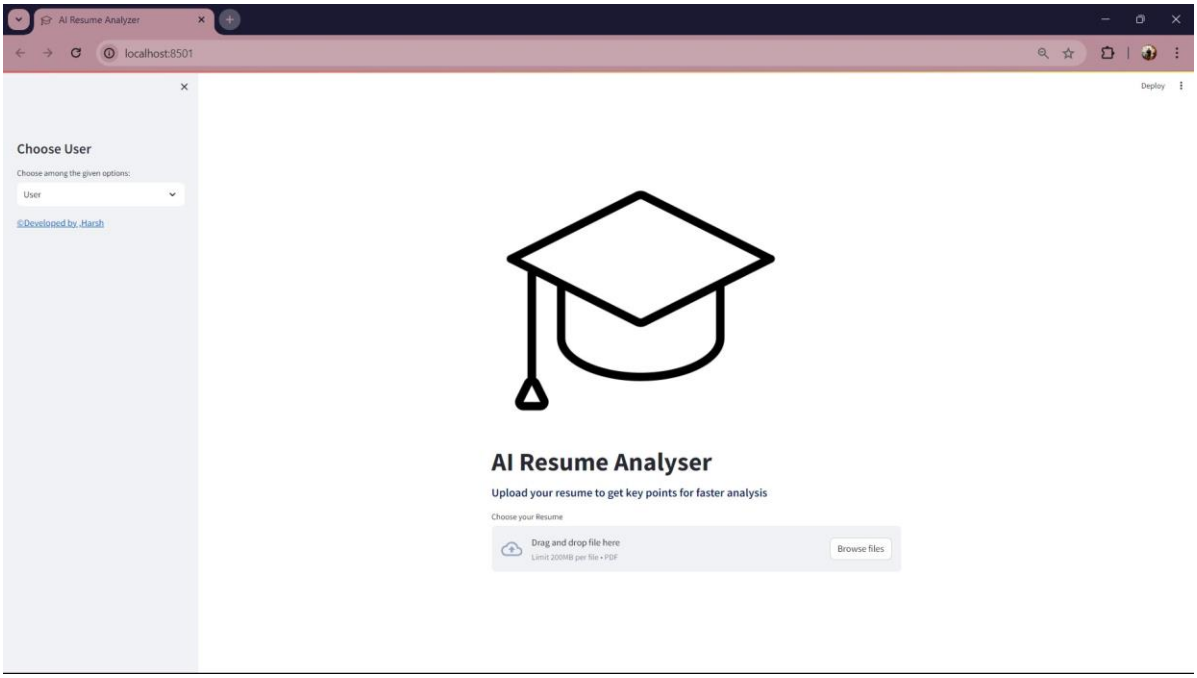
```
                cursor.execute('''SELECT*FROM user_data''')
                data = cursor.fetchall()
                st.header("**User's Data**")
                df = pd.DataFrame(data, columns=['ID', 'Name', 'Email', 'Resume
Score', 'Timestamp', 'Total Page',
                                                 'Predicted Field', 'User Level',
'Actual Skills', 'Recommended Skills',
                                                 'Recommended Course'])
                st.dataframe(df)
                st.markdown(get_table_download_link(df,'User_Data.csv','Download
Report'), unsafe_allow_html=True)
                ## Admin Side Data
                query = 'SELECT Predicted_Field, COUNT(*) as count FROM user_data
GROUP BY Predicted_Field;'
                plot_data = pd.read_sql(query, connection)

                ## Pie chart for predicted field recommendations
                labels = plot_data.Predicted_Field.unique()
                print(labels)
                values = plot_data.Predicted_Field.value_counts()
                print(values)
                st.subheader("**Pie-Chart for Predicted Field Recommendation**")
                fig = px.pie(plot_data, values='count', names='Predicted_Field',
title='Predicted Field according to the Skills')
                st.plotly_chart(fig)

                ### Pie chart for User's🗹Experienced Level
                labels = plot_data.User_level.unique()
                values = plot_data.User_level.value_counts()
                st.subheader("**Pie-Chart for User's Experienced Level**")
                fig = px.pie(df, values=values, names=labels, title="Pie-Chart🗹🗹
for User's🗹Experienced Level")
                st.plotly_chart(fig)


            else:
                st.error("Wrong ID & Password Provided")
run()
```

4.2 : Implementation

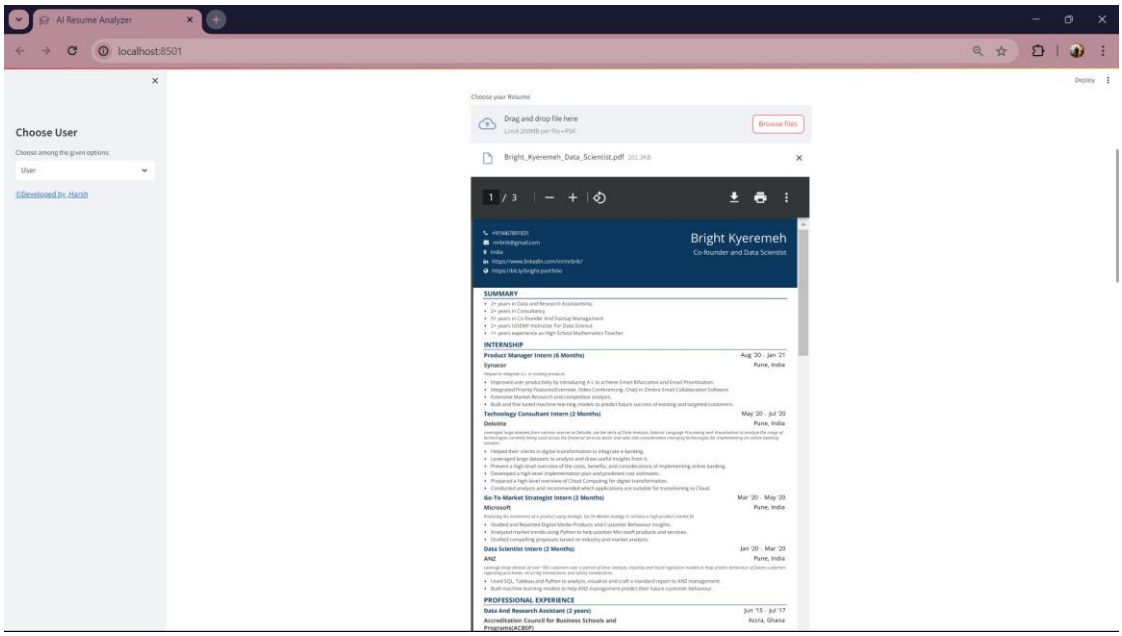


First run the code and to view it on browser run it using following command

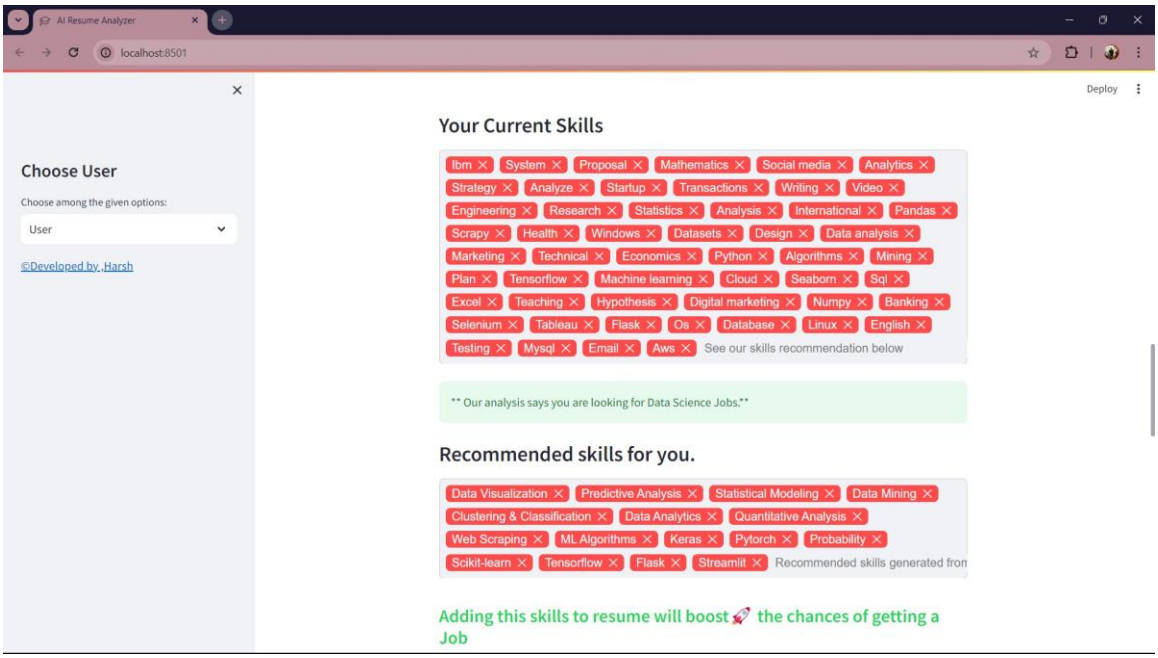
(python -m streamlit run d:/Project/NewPro/resume.py)

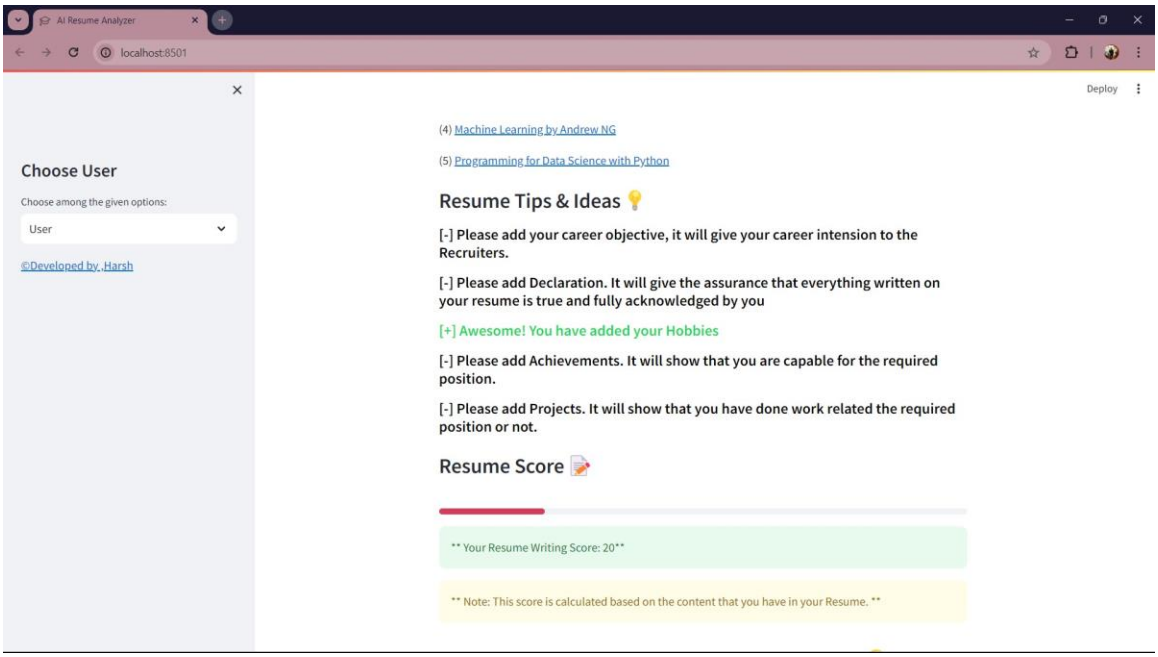


After running the command, the streamlit interface will look like this

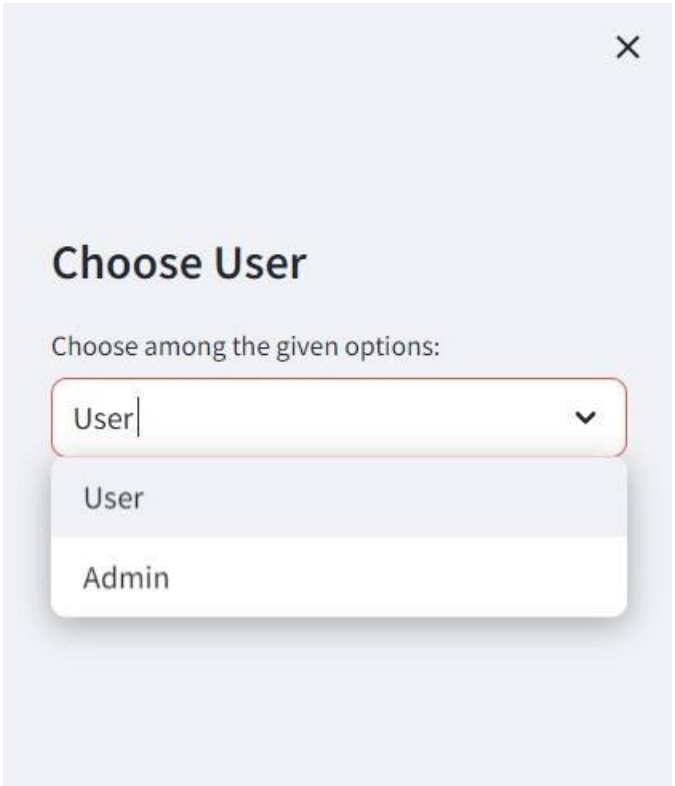


After that we can upload the resume

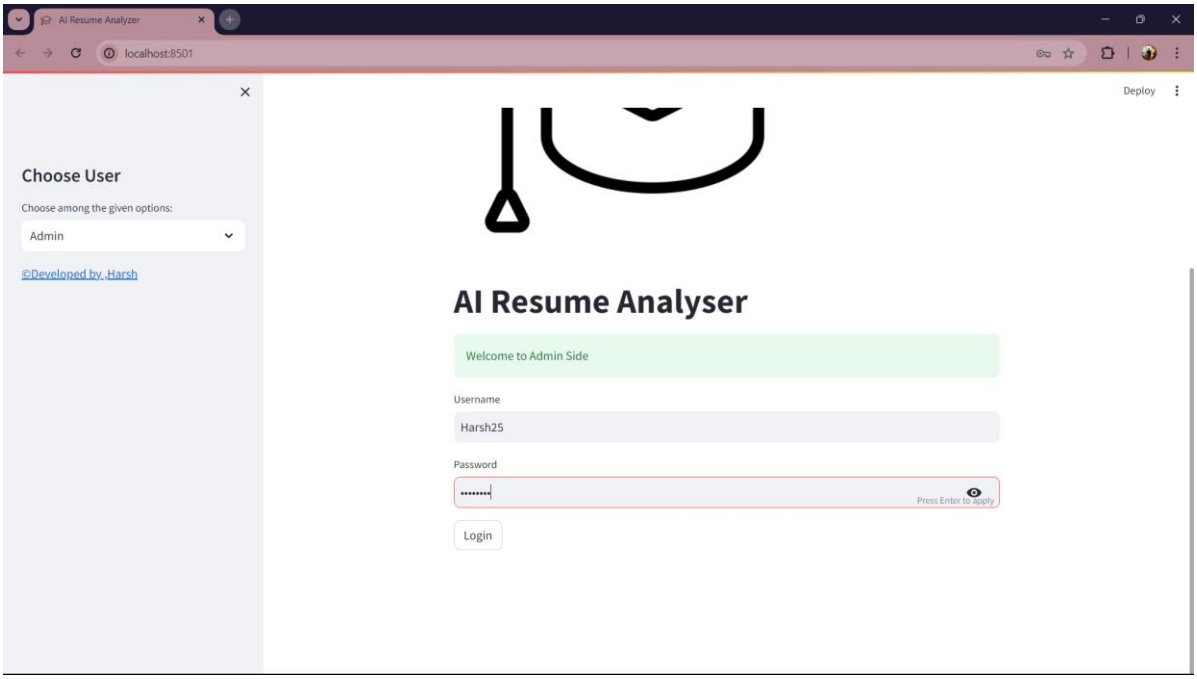




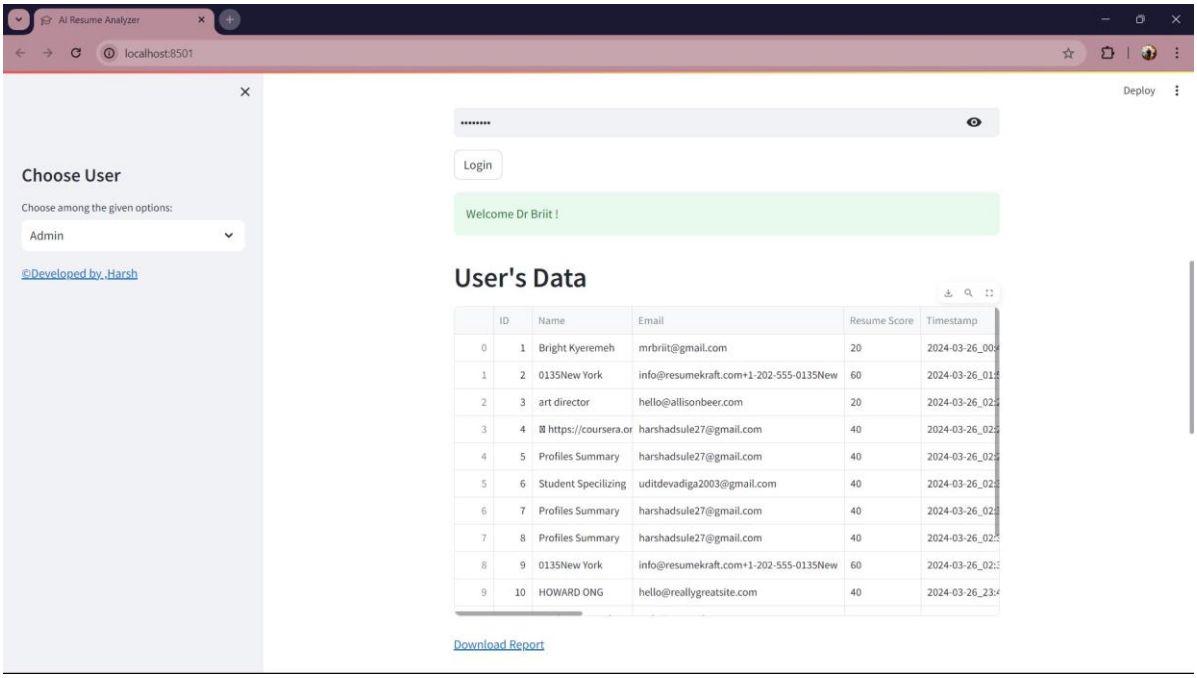
After that the analysis will look like this



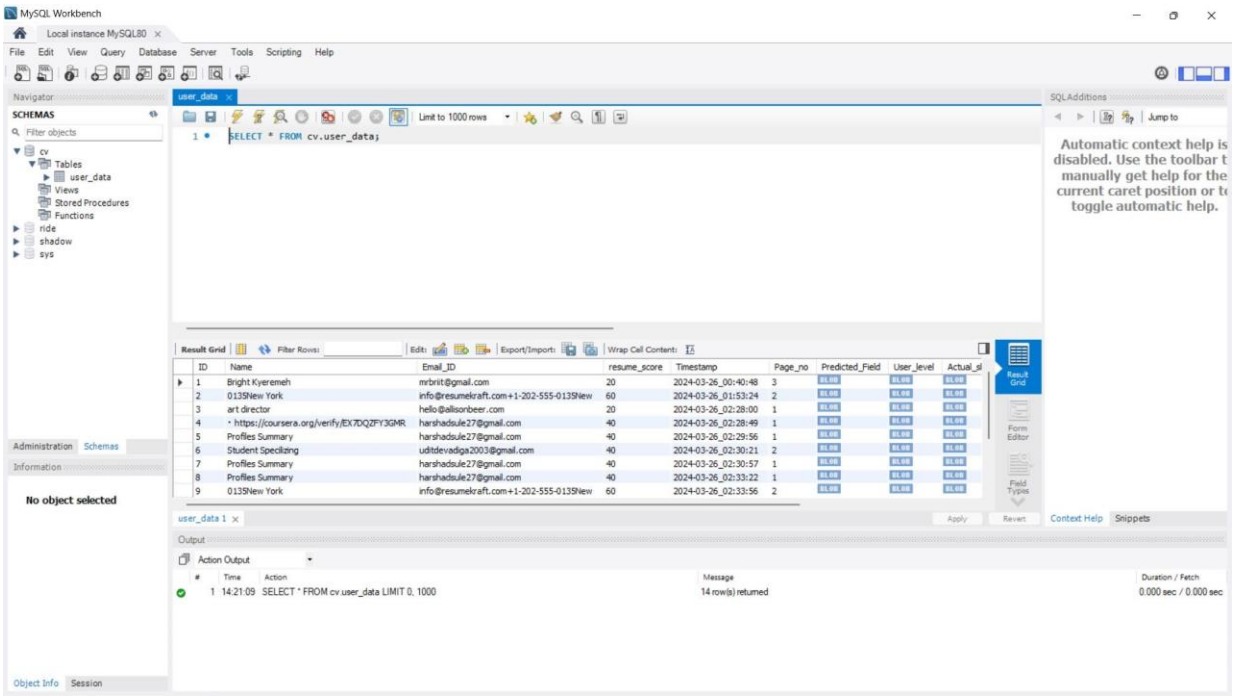
Also, this software has an admin panel where they can see all previously uploaded resume



After entering username password, you can enter into admin panel like this also you can download the reports in excel format



Also, this resume analyzer is connected to MySQL database there it saves all the information



CHAPTER 5: Evaluation

5.1 : Limitations

1. Limited Resume File Formats: The code only supports PDF format for resume upload. It does not handle other popular resume formats like .docx, .txt, or image formats (e.g., .jpg, .png). This could be limiting for users who have their resumes in different file formats.

2. Lack of Flexibility in Skill Categorization: The skill categorization and course recommendations are based on predefined keyword lists for specific domains (e.g., Data Science, Web Development, Android Development, etc.). This approach might not work well for resumes with skills that fall outside of these predefined categories or resumes with a combination of skills from different domains.

3. Limited Resume Content Analysis: The resume content analysis is focused on specific sections like Objective, Declaration, Hobbies, Achievements, and Projects. If a resume has a different structure or uses different section names, the analysis might not be accurate.

4. Reliance on External Libraries and Services: The code relies on several external libraries and services, such as PyResParser for resume parsing, NLTK for natural language processing, and YouTube APIs for fetching video titles. Any changes or issues with these external dependencies could impact the functionality of the application.

5. Lack of Multilingual Support: The code appears to be designed for English resumes only. It might not work well with resumes in other languages or might require additional language-specific processing.

6. No Error Handling or Validation: The code does not seem to include robust error handling or input validation mechanisms. This could lead to unexpected behavior or crashes in case of errors or malformed input data.

7. Database Integration: The code integrates with a MySQL database, which might not be suitable for all deployment environments or use cases. Additionally, the database schema and connection details are hardcoded, which could pose security risks and make it difficult to scale or migrate the application.

8. Lack of User Authentication and Authorization: The code does not appear to have any user authentication or authorization mechanisms in place. This could pose security risks and might not be suitable for scenarios where user data needs to be protected.

9. Performance and Scalability Concerns: Depending on the number of users and the volume of resume data, the application might face performance and scalability issues, especially with the computational tasks involved in resume parsing and analysis.

10. Limited Customization Options: The application does not seem to provide options for users to customize the analysis criteria or course recommendations based on their specific needs or preferences.

These limitations could be addressed through code improvements, additional features, and integration with more robust and scalable services or frameworks.

5.2: Future Scope:

1. Multi-Format Resume Support: Extend the application to support multiple resume file formats, such as .docx, .txt, and popular image formats (e.g., .jpg, .png). This would make the application more user-friendly and accessible to a wider range of users.

2. Improved Skill Categorization and Recommendation: Implement more advanced natural language processing techniques to better categorize skills and provide more accurate course recommendations. This could involve using machine learning models trained on a large dataset of resumes and job descriptions, allowing for more flexible and dynamic skill categorization.

3. Enhanced Resume Content Analysis: Incorporate more sophisticated techniques for analyzing the structure and content of resumes, such as named entity recognition, topic modeling, and sentiment analysis. This could provide deeper insights into the candidate's qualifications, experience, and suitability for specific roles.

4. Multilingual Support: Extend the application to support resumes in multiple languages by integrating language detection and translation capabilities. This would make the application more inclusive and cater to a global user base.

5. Robust Error Handling and Input Validation: Implement comprehensive error handling and input validation mechanisms to ensure the application behaves gracefully in case of errors or malformed input data. This would improve the overall user experience and reliability of the application.

6. User Authentication and Authorization: Implement user authentication and authorization features to ensure data privacy and security. This could involve

integrating with popular authentication providers (e.g., OAuth, social media logins) or implementing a custom authentication system.

7. Improved Database Integration and Scalability: Explore more scalable and robust database solutions, such as cloud-based or distributed databases, to handle large volumes of user data and resume analysis results. Additionally, consider implementing database connection pooling and other performance optimization techniques.

8. Web Application or Mobile App Development: Develop a user-friendly web application or mobile app interface for the resume analysis tool, making it more accessible and convenient for users to interact with the application.

9. Collaborative Features: Implement collaborative features that allow multiple users (e.g., recruiters, hiring managers, or team members) to review and provide feedback on resume analysis results, facilitating better decision-making and collaboration in the hiring process.

10. Analytics and Reporting: Incorporate comprehensive analytics and reporting capabilities to provide insights into resume analysis trends, user behavior, and other relevant metrics. This could aid in identifying areas for improvement and making data-driven decisions.

These future scopes demonstrate the potential for expanding the application's capabilities, improving user experience, and integrating with other systems or services to create a more comprehensive and valuable solution for resume analysis and candidate evaluation.

Conclusion:

The provided code is a comprehensive application that aims to assist users in analyzing their resumes and receiving personalized recommendations for skill improvements and relevant courses. The application leverages various libraries and technologies, including Streamlit for the user interface, PyResParser for resume parsing, NLTK for natural language processing, and integration with a MySQL database for storing user data.

While the application offers a wide range of features, such as resume scoring, skill categorization, course recommendations, and bonus video suggestions for resume writing and interview tips, there are several limitations and potential areas for improvement. These include limited support for resume file formats, inflexible skill categorization, limited resume content analysis, reliance on external libraries and services, lack of multilingual support, insufficient error handling and input validation, database integration concerns, lack of user authentication and authorization, potential performance and scalability issues, and limited customization options.

To address these limitations and enhance the application's capabilities, several future scopes have been identified. These include supporting multiple resume file formats, improving skill categorization and recommendation techniques through advanced natural language processing and machine learning models, enhancing resume content analysis with techniques like named entity recognition and topic modeling, introducing multilingual support, implementing robust error handling and input validation mechanisms, exploring more scalable and robust database solutions, developing user-friendly web or mobile app interfaces, integrating with job boards and applicant tracking systems, introducing customizable analysis and recommendation settings, implementing collaborative features for team-based resume review, and incorporating comprehensive analytics and reporting capabilities.

By leveraging these future scopes, the application can evolve into a more robust, intelligent, and user-friendly solution for resume analysis and candidate evaluation. It can cater to a wider range of users, provide more accurate and personalized recommendations, and integrate seamlessly with other systems and services in the recruitment and hiring ecosystem.

Overall, the provided code serves as a solid foundation for a resume analysis application, but its true potential can be unlocked by addressing its current limitations and embracing the identified future scopes, paving the way for a more comprehensive and valuable solution in the recruitment and talent acquisition domain.

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These research papers and references cover various aspects of the AI Resume Analyzer project, including resume parsing, skill extraction, course recommendation systems, natural language processing techniques, user experience design, database design, and general topics related to AI in hiring and employment.