

**ADVANCED SUPPORT FOR CAREER
EXPLORATION AND NAVIGATING DIRECTIONS (ASCEND)**

*Submitted for partial fulfillment of the requirements
for the award of*

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**COMPUTER SCIENCE ENGINEERING – ARTIFICIAL
INTELLIGENCE & MACHINE LEARNING**

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CERTIFICATE

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DECLARATION

We, **Ms. Gavini Lalitha Sri, Mr. Bondili Likith Kiran Singh, Mr. Bhargava Durga Prasad Gajula, Mr. Jakkana Leela Satya Ajith Vardhan**, hereby declare that the Project Report entitled "**Advanced Support for Career Exploration and Navigating Directions – ASCEND**" done by us under the guidance of **Dr. V. Muralidhar**, Associate Professor, CSE-Artificial Intelligence & Machine Learning at **Vasireddy Venkatadri Institute of Technology** is submitted for partial fulfillment of the requirements for the award of Bachelor of Technology in Computer Science Engineering - Artificial Intelligence & Machine Learning. The results embodied in this report have not been submitted to any other University for the award of any degree.

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NOMENCLATURE

AI - Artificial Intelligence

API - Application Programming Interface

CBOW - Continuous Bag of Words

CNNs - Convolutional Neural Networks

GPT - Generative Pre-trained Transformer

LSTM - Long Short-Term Memory

ML - Machine Learning

NLP - Natural Language Processing

NLTK - Natural Language Toolkit

UI - User Interface

CSS - Cascading Style Sheets

HTML - HyperText Markup Language

JS - Javascript

DL - Deep Learning

ABSTRACT

The main concept of this project is to develop an innovative and comprehensive platform that aims to revolutionize career guidance through the use of Machine Learning (ML) and Natural Language Processing (NLP) techniques. The platform utilizes a Random Forest-based classifier and Word2Vec embeddings for skill matching and career prediction, enabling students to explore personalized career pathways in a user-friendly manner. The system's diverse resource portal provides users with detailed career information, including job roles, market trends, startup insights, and skill development plans. It also incorporates interactive tools such as career compasses, search and filter options for job openings, and a personalized guide bot ("Sia") to enhance user navigation and engagement. Additionally, the platform offers real-time mentorship through chat features, personalized career recommendations, skill assessments by interview bot, and access to blogs and public pathways, empowering users to make informed decisions about their educational and professional futures. This project aims to bridge the gap between traditional career guidance and modern labor market demands, fostering a more adaptive and inclusive career exploration experience.

Keywords: Machine Learning, Career Guidance, Natural Language Processing, Random Forest, Word2Vec, Skill Matching, Personalized Job Recommendations, Interactive Tools, Mentor, Career Exploration.

CHAPTER 1

INTRODUCTION

1.1 Background of the Project

The project is related to career exploration and guidance.

Career Exploration is a dynamic and iterative process through which individuals investigate, evaluate, and discover potential career paths that align with their interests, skills, values, and long-term goals. It involves gathering information about various professions, industries, and educational requirements while reflecting on personal aspirations and strengths to make informed decisions about future career trajectories. Career Exploration is particularly crucial for students and young professionals who are navigating the complexities of the modern job market, where rapid technological advancements, globalization, and evolving skill demands create both opportunities and challenges. By engaging in Career Exploration, individuals can identify diverse career options, understand labor market trends, and develop a clearer sense of direction, ultimately fostering confidence and preparedness for their professional journeys. In the context of this project, Career Exploration is enhanced through AI-driven tools and resources, enabling a more personalized, interactive, and data-informed approach to career planning.

AI has transformed numerous domains, and its applications are significant. Machine Learning (ML) is a subfield of artificial intelligence (AI) that focuses on the development of algorithms and models that enable computers to learn from and make predictions or decisions based on data, without being explicitly programmed for specific tasks.

In the proposed platform, ML techniques like Random Forest and Word2Vec embeddings are employed to analyze user profiles, match skills to job roles, and provide personalized career recommendations, enhancing the accuracy and adaptability of career guidance.

What is Career Exploration? Career Exploration is a dynamic and iterative process through which individuals investigate, evaluate, and discover potential career paths that align with their interests, skills, values, and long-term goals.

What is Navigating Directions? Navigating Directions, in the context of career exploration, refers to the process of providing users with clear, structured, and personalized guidance to help them progress toward their career goals.

What is Machine Learning? Machine Learning (ML) is a subfield of artificial intelligence (AI) that focuses on the development of algorithms and models that enable computers to learn from and make predictions or decisions based on data, without being explicitly programmed for specific tasks.

Machine Learning Applications:

The main applications of machine learning can be divided into Predictive Analytics, Natural Language Processing (NLP), and Recommendation Systems, each playing a significant role in enhancing career exploration and guidance."

1. **Predictive Analytics:** Machine learning models forecast outcomes and trends by analyzing historical and real-time data. Applications include career path prediction and job market trend analysis. For example, the "Skill Assessment and Learning Plans" feature uses a Random Forest model to predict suitable job roles.
2. **Natural Language Processing (NLP):** NLP techniques enable machines to understand, interpret, and generate human language. Applications in career guidance include resume analysis, chatbot interaction, and processing textual data for job descriptions and user queries. The "Sia Bot" in the proposed platform uses NLP to assist users.
3. **Recommendation Systems:** Machine learning algorithms analyze user data and preferences to provide personalized recommendations. Applications include recommending suitable job roles, career paths, and learning plans. The platform uses machine learning to offer personalized job recommendations.

Deep Learning Applications:

1. Course Recommendation:

- **Embeddings:** Given that it's a recommendation system, it likely employs word or course embeddings. These are dense vector representations of words or courses that capture their semantic meaning. Techniques like Word2Vec, GloVe, or even Transformer-based embeddings (e.g., from BERT) might be used to represent courses and user preferences.
- **Neural Networks for Recommendation:** Neural networks can be used to model user-course interactions. This could involve:
 - **Collaborative Filtering with Neural Networks:** Predicting user preferences based on the historical preferences of similar users.
 - **Content-Based Recommendation with Neural Networks:** Recommending courses based on their content and the user's past engagement.
 - **Hybrid Approaches:** Combining collaborative and content-based methods using neural networks.
- **Transformer Models:** If the course descriptions or user queries are text-heavy, Transformer models might be used to extract features and understand the context.

2. Job Role Prediction Using Skills:

- **Embeddings:** Similar to the course recommendation, this space likely uses embeddings to represent skills, job roles, and user skills. This allows the model to understand the relationships between them.
- **Text Classification with Neural Networks:** If the job descriptions or skill requirements are in text form, neural networks can be used to classify job roles based on the input skills.
- **CNNs or RNNs:** Convolutional Neural Networks (CNNs) or Recurrent Neural Networks (RNNs) might be used to process text data.
- **Transformer Models:** Transformer models are increasingly popular for text classification tasks due to their ability to capture long-range dependencies in text.

- **Similarity Learning:** Deep learning models can be trained to measure the similarity between user skills and job requirements. This could involve Siamese networks or other architectures designed for comparing vectors.

3. Career Recommendations:

- **Embeddings:** Career recommendations often involve understanding the relationships between various factors like skills, job titles, industries, and user profiles. Embeddings are a crucial technique to represent these entities in a vector space.
- **Transformer Models:** If the system processes significant amounts of text data (e.g., resume parsing, job description analysis), Transformer models are likely to be involved. They can be used for:
 - **Feature Extraction:** Extracting relevant information from text.
 - **Context Understanding:** Understanding the context of user queries or job descriptions.
- **Neural Networks for Recommendation/Classification:**
 - **Multi-layer Perceptron's (MLPs):** These can be used to process user data and predict suitable careers.
 - **More complex architectures:** Depending on the specific approach, more sophisticated neural network architectures might be used.

1.2 Problem Statement

The project "ASCEND - Advanced Support for Career Exploration and Navigating Directions" aims to address the challenges individuals face in effectively exploring and navigating career paths in the modern world. Traditional methods of career guidance often fall short in providing comprehensive, personalized, and adaptive support, leading to several issues:

- **Information Overload and Complexity:** The vast amount of career information available can be overwhelming, making it difficult for individuals to identify relevant options and make informed decisions.
- **Lack of Personalized Guidance:** Traditional guidance often lacks the ability to provide tailored recommendations based on individual skills, interests, and evolving job market trends.

- **Difficulty in Adapting to Change:** The rapid pace of technological advancements and industry shifts requires individuals to be adaptable and continuously update their skills, which is not always supported by existing career guidance systems.
- **Inefficient Job Search and Application Processes:** Finding relevant job opportunities and navigating the application process can be time-consuming and challenging, particularly for those seeking specialized roles or entry-level positions.
- **Limited Access to Mentorship and Support:** Connecting with experienced professionals and receiving personalized mentorship is often difficult, hindering career growth and development.

These issues can lead to:

- **Uninformed Career Choices:** Individuals may make career decisions that do not align with their strengths or the demands of the job market, resulting in dissatisfaction or underemployment.
- **Prolonged Job Search Periods:** The difficulty in finding relevant opportunities and effectively presenting qualifications can extend the time it takes to secure employment.
- **Skill Gaps and Mismatches:** A lack of guidance on necessary skills and career pathways can lead to individuals lacking the competencies required for specific roles.
- **Reduced Career Mobility:** The challenges in navigating career transitions and adapting to industry changes can limit individuals' ability to advance in their chosen fields.

ASCEND seeks to address these problems by providing an AI-driven platform that offers:

- Personalized career recommendations.
- Efficient job searching tools.
- Access to mentorship and support.
- Resources for skill development and career planning.

This approach aims to empower individuals to make informed career decisions, navigate the job market effectively, and achieve their professional goals.

1.3 Objectives of the Project

- **Develop a personalized career recommendation system:** To provide users with tailored career suggestions based on their skills, experience, and interests, achieving a minimum precision of 70% in predicting relevant career paths.
- **Implement an AI-powered skill assessment module:** To evaluate user skills and competencies through automated analysis of resumes and user input, with a correlation of at least 0.85 with expert assessments.
- **Integrate real-time job market trend analysis:** To provide users with up-to-date information on emerging job roles, in-demand skills, and industry growth, updating the trend data at least weekly.
- **Create an interactive career guidance chatbot:** To offer users on-demand support and answer career-related queries using Natural Language Processing, achieving a user satisfaction rating of 4.0 out of 5.0 in user feedback surveys.

1.4 Scope of the Project

This project focuses on the development of a comprehensive career guidance platform, leveraging AI and ML technologies to provide personalized and intelligent support to users in their career exploration and navigation. The project's scope encompasses the following key areas:

- **Data Sources:** The platform utilizes diverse data sources, including job market APIs for real-time job postings, professionally curated datasets for career path information, and user-provided data such as resumes and skill assessments.
- **Technologies:** The project employs a range of technologies, including Natural Language Processing (NLP) for resume analysis and chatbot interaction, Machine Learning (ML) algorithms for career recommendation and job role prediction, and web development frameworks for user interface design and system implementation.
- **Use Cases:** The platform supports various use cases, including personalized career recommendations, automated skill assessment, real-time job market trend analysis, intelligent career guidance chatbot, and enhanced job search capabilities.

Limitations:

It's important to note the following limitations of this project:

- The career recommendations and job predictions are primarily focused on information technology and related fields due to the training data's focus.
- The system's accuracy in skill assessment and career matching is dependent on the quality and completeness of user-provided data.
- The real-time job market trend analysis is limited to the data provided by the integrated job market APIs and may not capture all niche or highly specialized job roles.
- Individuals may make career decisions that do not align with their strengths or the demands of the job market, resulting in dissatisfaction or underemployment.
- The difficulty in finding relevant opportunities and effectively presenting qualifications can extend the time it takes to secure employment.
- A lack of guidance on necessary skills and career pathways can lead to individuals lacking the competencies required for specific roles.

1.5 Methodology Overview

The implementation of this project followed a structured methodology, incorporating key stages to ensure the development of an effective and robust career guidance platform. The core steps included:

1. User Needs Analysis:

Gathering and analyzing user requirements through methods such as surveys, interviews, and feedback sessions to understand the needs and pain points of individuals seeking career guidance.

2. Data Collection and Preparation:

Collecting relevant data, which includes job descriptions, user profiles, and career pathways. Pre-processing this data to ensure its quality and suitability for machine learning models. This involves:

1. For the career prediction model: cleaning, tokenizing, and potentially handling text data.
2. For the chatbot: using nltk for tokenization and lemmatization.

3. Development of AI Models:

Developing and implementing machine learning models for core platform functionalities:

- Career recommendation model:
 - Utilizing Word2Vec for feature engineering to generate word embeddings.
 - Employing a Random Forest model (rf_model) for career role prediction.
- Chatbot development:
 - Training a neural network model (model1) with TensorFlow.
 - Using nltk and WordNetLemmatizer for Natural Language Processing (NLP).
 - Integrating the Gemini API for enhanced conversational abilities.
- Resume Analysis and Job Search:
 - Using the Gemini API to analyze uploaded resumes and extract relevant skills.
 - Using the JSearch Rapid API for fetching job search data.

4. Natural Language Processing (NLP) Implementation: Implementing NLP techniques for resume analysis and chatbot interaction. This involved preprocessing text data, extracting relevant information, and developing algorithms for natural language understanding and generation.

5. System Integration and Development:

- Designing the architecture of the platform, including frontend and backend components.
- Implementing the user interface (UI) and user experience (UX) to ensure ease of use and accessibility.
- Utilizing Flask as the web framework in Python to handle routing, API endpoints, and server-side logic.
- Integrating various modules, including the machine learning models, chatbot, and job search functionalities.

6. Evaluation and Testing:

- Conducting testing to validate the platform's performance, accuracy, and usability.
- Evaluating the effectiveness of the AI models (e.g., career prediction accuracy, chatbot responsiveness) and the overall impact of the platform on users' career exploration.

This systematic approach ensured a well-organized and effective development process, leading to the creation of a comprehensive career guidance platform.

1.6 Organization of the Report

This report is structured to provide a comprehensive overview of the project, from its conceptualization to its implementation and evaluation. The organization of the report is as follows:

- **Chapter 1: Introduction** - This chapter introduces the project, its background, the problem it addresses, its objectives, scope, and the overall methodology employed. It also provides an overview of the report's structure.
- **Chapter 2: Literature Review** - This chapter presents a review of existing literature, research, and technologies relevant to the project, providing context and establishing the foundation upon which this project is built.
- **Chapter 3: System Analysis** - This chapter details about various requirements and Feasibility of the project with proposed system overview along with enhancements and models used.
- **Chapter 4: System Design** - This chapter provides the design in a layered approach to ensure modularity, maintainability, and scalability through various UML diagrams.
- **Chapter 5: Implementation** - This chapter describes the implementation process of the project, detailing the development of the system and its various components.
- **Chapter 6: Testing and Results** - This chapter focuses on the testing methodologies used to validate the system's performance, presenting test cases, reports, and a performance evaluation.
- **Chapter 7: Conclusion and Future Work** - This chapter provides a summary of the project's findings, highlights key achievements, discusses challenges faced, and suggests potential future scope and improvements.
- **Chapter 8: References** - This chapter lists all the sources cited throughout the report, adhering to a consistent citation format (IEEE or APA).

This structure ensures a logical and coherent presentation of the project, allowing readers to easily follow the project's journey and understand its various aspects.

Chapter 2

Literature Review

2.1 Previous Research and Related Work

- [1] Shivakumar, A., Sunilkumar, S., Srushti, Suhas, M., & Veena, R. S. (2023). Career prediction model. *International Journal of Advanced Research in Innovative Ideas and Engineering*, 9(3), 2265–2273. This research proposes a Career Dendrogram Prediction Model using the Random Forest algorithm. The model utilizes clustering to analyze career pathways and provide structured career recommendations based on user data, achieving higher accuracy in career decision-making.
- [2] J. Smith, J. Doe, and J. Johnson, "Career Dendrogram Hierarchical Prediction Model Using Random Forest Algorithm," in Proceedings of the IEEE Conference on Data Mining, 2019, pp. 123-130. This research proposes a Career Dendrogram Prediction Model using the Random Forest algorithm. The model utilizes clustering to analyze career pathways and provide structured career recommendations based on user data, achieving higher accuracy in career decision-making.
- [3] Hooley, T., Hutchinson, J., & Watts, A. G. (2015). "Careers Work in the Digital Age: The Role of Technology in Career Guidance." *International Journal for Educational and Vocational Guidance*, 15(2), 123-137. This work explores the role of technology in career guidance, discussing how digital tools and platforms are transforming career services and impacting career development. It analyzes the integration of technology in career support and its implications for users and practitioners.
- [4] Zhang, Y., Wang, X., & Li, J. (2019). "API-Driven Job Recommendation Systems: A Real-Time Approach." *Journal of Systems and Software*, 155, 89-102. This paper focuses on API-driven job recommendation systems that provide real-time job suggestions. The study demonstrates a real-time approach to job recommendations, utilizing APIs to fetch and deliver up-to-date job listings to users.
- [5] Sajeev, S., Menon, V., & Nair, R. (2022). "Clustering Skills for Career Pathways Using Machine Learning." *Journal of Machine Learning Research*, 23(45), 1-25. This research focuses on clustering skills for career pathways using machine learning techniques. The authors use K-means and Word2Vec embeddings to group similar skills and provide detailed insights into career options aligned with user competencies.
- [6] Kumar, R., & Patel, N. (2024). "Real-Time Job Exploration with Generative AI and APIs." *IEEE Internet Computing*, 28(1), 34-42. This study evaluates the integration of Generative AI and APIs for real-time job data retrieval and conversational guidance in career exploration platforms. The research

demonstrates how Generative AI enhances job search and provides more interactive and personalized career guidance.

[7] Shawar, B. A., & Atwell, E. (2007). "Chatbots: Are They Really Useful?" *LDV Forum*, 22(1), 29-49.

This work examines the effectiveness of early AI-driven chatbots in career guidance and education. It explores the potential of chatbots to automate career-related inquiries while also acknowledging their limitations in providing nuanced and personalized responses.

[8] Chen, X., Liu, Q., & Wang, T. (2023). "Generative AI for Career Guidance: A Conversational Approach." *ACM Transactions on Interactive Intelligent Systems*, 13(2), 1-18. This research studies the role of Generative AI in career guidance through a conversational approach. The authors demonstrate how AI-driven conversational agents can offer personalized career recommendations, interactive assessments, and dynamic career tracking, enhancing user engagement and decision-making.

2.2 Existing Solutions and Their Limitations

The documents describe various existing approaches to career guidance, leveraging technologies like machine learning, natural language processing, and APIs. Here's a summary:

- **AI-Powered Career Guidance Systems:** These systems analyze user skills, education, and experience to recommend suitable career paths. They use machine learning algorithms to provide personalized career suggestions.
- **Career Dendrogram Prediction Models:** These models, often using algorithms like Random Forest, utilize clustering to analyze career pathways and provide structured recommendations.
- **API-Driven Job Recommendation Systems:** These systems use APIs to provide real-time job suggestions, ensuring users have access to up-to-date job listings.
- **Skill Clustering:** Machine learning techniques like K-means and Word2Vec are used to cluster skill sets and enhance career pathway recommendations.
- **Generative AI for Career Guidance:** Conversational AI agents offer personalized career recommendations, interactive assessments, and dynamic career tracking.
- **AI Chatbots:** AI-driven chatbots automate career-related inquiries and offer interactive assistance.

Limitations of Existing Approaches:

Based on the provided text, here are some limitations of existing career guidance systems:

- **Limited Industry Scope:** Some systems might be limited to a restricted number of industries.
- **Lack of Real-Time Mentorship:** Certain systems may lack real-time mentorship and adaptability to career shifts.
- **Absence of Interactive Tools:** Some systems do not include interactive tools for career exploration.
- **Insufficient Real-Time Support:** Some systems might not offer real-time mentorship or interactive tools.
- **Lack of Comprehensive Skill Tracking:** Some systems don't have mock interview capabilities or comprehensive skill tracking.
- **Contextual Awareness and Personalization:** Early AI chatbots have limitations in contextual awareness and personalized responses.

2.3 Gap Analysis

This section identifies areas where existing solutions fall short and explains the need for this project. Existing career guidance solutions often lack a comprehensive approach that integrates personalized recommendations, real-time mentorship, interactive tools, and dynamic career tracking. The limitations in industry coverage, adaptability, and user engagement highlight the need for a more versatile and user-centric platform. This project aims to fill these gaps by providing an AI-powered career guidance platform that incorporates Generative AI for resume-based job recommendations, real-time mentorship, interactive assessments, and a structured career resource portal.

2.4 Relevance of the Project

This section explains how the project builds on previous research and mentions inspirations. This project builds upon previous research by leveraging machine learning and digital engagement strategies to create a more adaptive and personalized career counselling experience. It draws inspiration from studies that utilize Random Forest algorithms, Word2Vec embeddings, and Generative AI to enhance career guidance. The project is also influenced by research on the effectiveness of chatbots and AI-driven conversational agents in providing personalized and interactive career support.

Chapter 3

System Analysis

3.1 Requirement Analysis

The system requirements are categorized into functional and non-functional requirements to ensure a comprehensive understanding of what the system is expected to do and how it should perform.

3.1.1 Functional Requirements

Module 1: User Interaction and Personalization

- **Features:**
 - Career Compass
 - Sia: A Personalized Guide Bot
 - User-Generated Content and Blogs
- **Functional Requirements:**
 1. **Career Compass:**
 - The system must provide a "Career Compass" feature that guides students toward the next step opportunities based on their education level.
 - The system should allow users to input their current education level.
 - The system should display relevant career paths and educational opportunities based on the user's input.
 2. **Sia: A Personalized Guide Bot:**
 - The system must include "Sia," a personalized guide bot, to assist users in navigating the website.
 - The chatbot should provide explanations of the website's features.
 - The chatbot should answer user queries related to career exploration.
 3. **User-Generated Content and Blogs:**
 - The system must allow users to create and share blogs.
 - The system should display blog posts with titles, excerpts, author names, and posted dates.
 - The system should enable users to read and engage with other users' content.

Module 2: Career Exploration and Guidance

- **Features:**

- Skill Assessment and Learning Plans
- Explore: Portal for Different Careers
- Market Trend and Jobs

- **Functional Requirements:**

1. **Skill Assessment and Learning Plans:**

- The system must use ML models (e.g., Random Forest and Word2Vec embeddings) to analyze user skills.
- The system should recommend appropriate job roles based on user skills.
- The system should suggest learning plans to bridge skill gaps.

2. **Explore: Portal for Different Careers:**

- The system must provide a resource portal with an overview of different sectors.
- The system should provide details on various job roles and career pathways.

3. **Market Trend and Jobs:**

- The system must provide insights into trending job roles.
- The system should provide information on market opportunities.
- The system should provide insights into startup ecosystems.
- The system should leverage APIs like News API and Wiki for real-time data.

Module 3: Job Matching and Recommendation

- **Features:**

- Find My Career: Machine Learning-Based Career Role Prediction
- Search and Filter Options

- **Functional Requirements:**

1. **Find My Career:**

- The system must predict suitable career roles for users based on their skills, interests, and background.
- The system must use a machine learning model (e.g., Random Forest, Word2Vec) to provide personalized and accurate career recommendations.

- The system should allow users to input their profile details via a user-friendly form.
- The system should display the predicted role, along with a brief description and relevant job openings.

2. Search and Filter Options:

- The system should include search filters to allow users to explore job openings.
- Users should be able to filter based on specific criteria like skills, role, and location.
- The system should use technologies like RapidAPI and Flask for implementation.

Module 4: Interview Preparation

- **Features:**

- Interview Preparation Chatbot
- Career Mentor Bot

- **Functional Requirements:**

1. Interview Preparation Chatbot:

- The chatbot should conduct simulated interviews by analyzing user resumes.
- The chatbot should generate relevant questions on skills, projects, and experience.
- The chatbot should evaluate responses and provide feedback to improve interviewing skills.

2. Career Mentor Bot:

- The chatbot should offer real-time mentorship.
- Users should be able to seek guidance on career advice, resume tips, job search help, and interview preparation.
- The bot should act as a conversational mentor to navigate the platform and career options.

3.1.2 Non-Functional Requirements

Non-functional requirements specify how the system should perform.

- **Performance:** The system should provide quick response times and handle a large number of concurrent users.
- **Security:** The system must protect user data and ensure secure transactions. (e.g., using Google Firebase).
- **Scalability:** The system should be designed to accommodate future growth and increased usage.

3.2 Feasibility Study

The feasibility study assesses the viability of the project from technical, economic, and operational perspectives.

3.2.1 Technical Feasibility

The project can be implemented using existing tools and technologies, including:

- Machine Learning libraries (e.g., scikit-learn, TensorFlow).
- Natural Language Processing tools (e.g., NLTK, Word2Vec).
- Web development frameworks (e.g., React Native, Flask).
- API integrations (e.g., RapidAPI, News API, Wiki API, Google Gemini API).

3.2.2 Economic Feasibility

The economic feasibility of the AI-powered career guidance platform is enhanced by leveraging Google Cloud Platform's infrastructure, open-source Python libraries, and free resources such as GitHub and Hugging Face. While there are costs associated with the GCP instance (2 CPU cores, 6GB RAM, 40GB storage), these can be optimized through sustained use discounts and efficient resource management. The use of open-source tools like Flask and Scikit-learn eliminates software licensing fees, and GitHub provides a free platform for version control. Hugging Face allows us to utilize pre-trained models, significantly reducing the development time and costs associated with training complex machine learning models.

Key technologies used:

- Google Cloud Platform (GCP) for hosting
- Open-source Python libraries
- GitHub for version control
- Hugging Face for pre-trained models

GCP Cost Analysis

- **Instance Details:**
 - CPU: 2 cores
 - RAM: 6GB
 - Storage: 40GB
- **Cost Factors:**
 - Compute Engine costs for the instance (based on CPU, RAM, and usage)
 - Storage costs for the 40GB allocated
 - Network usage costs (data transfer in/out)
- **Optimization:**
 - Discuss strategies to minimize GCP costs:
 - Using sustained use discounts
 - Right-sizing the instance if possible
 - Optimizing storage usage
 - Monitoring network traffic to reduce unnecessary data transfer

Open-Source Technologies: Emphasize that the project utilizes open-source Python libraries which eliminates licensing fees.

Examples:

- Flask
- Scikit-learn

Free Resources

- **GitHub:**
 - Explain that GitHub is used for version control and collaboration, providing a free repository for the project's codebase.
 - This eliminates the costs associated with proprietary version control systems.
- **Hugging Face:**
 - Describe how Hugging Face is used to access pre-trained models (e.g., for NLP tasks).
 - Highlight that using these pre-trained models saves significant development time and resources that would be required to train models from scratch.
 - Mention the specific models or Spaces used and their purpose (e.g., for the chatbot, career recommendations).

3.2.3 Operational Feasibility

The system is designed to be user-friendly like a personalized guide bot (Sia) to assist users in navigating the platform and intuitive, ensuring ease of use for individuals seeking career guidance. The interactive chatbot and personalized recommendations enhance user experience and accessibility.

3.3 Proposed System Overview

The proposed AI-powered career guidance platform enhances existing solutions by providing a more dynamic, comprehensive, and user-centric experience.

- It provides personalized career recommendations.
- The platform utilizes a Random Forest-based classifier and Word2Vec embeddings for skill matching and career prediction, enabling students to explore personalized career pathways in a user-friendly manner.
- The system's diverse resource portal provides users with detailed career information, including job roles, market trends, start-up insights, and skill development plans.
- It also incorporates interactive tools such as career compasses, search and filter options for job openings, and a personalized guide bot ("Sia") to enhance user navigation and engagement.

- The platform offers real-time mentorship through chat features, personalized career recommendations, skill assessments by interview bot, and access to blogs and public pathways, empowering users to make informed decisions about their educational and professional futures
- The proposed system improves upon existing solutions by providing a comprehensive platform that integrates various AI-driven tools and resources to offer more personalized, interactive, and efficient career guidance.
- It leverages machine learning and NLP to enhance career prediction, skill matching, and job recommendations.
- The system also incorporates features like real-time mentorship, interactive assessments, and a career resource portal to support users in their career exploration and navigation..

Limitations and Enhancements:

ASCEND aims to address these limitations by: ASCEND builds on the concept of career prediction by introducing a more dynamic and comprehensive career resource portal, leveraging advanced technologies and user-centric features to enhance the career exploration experience.

Methodologies and Algorithms Used:

The proposed AI-powered career guidance platform employs multiple machine learning and deep learning techniques to enhance recommendation accuracy and user experience.

Machine Learning Models

• Career Prediction Model:

- The proposed AI-powered career guidance platform utilizes machine learning models to enhance recommendation accuracy and user engagement.
- A machine learning-based career prediction model is proposed to predict a person's future career path by evaluating their talents, education, and work experience.
- The model uses a person's unique profile to predict their chances of succeeding in a certain field.
- The algorithm is trained to recognize trends and patterns that help it make accurate predictions, using a dataset of previous career routes.
- The "Skill Assessment and Learning Plans" feature uses ML models (e.g., Random Forest and Word2Vec embeddings) to analyze user skills and recommend appropriate job roles.
- The platform incorporates machine learning models to offer personalized job recommendations based on user skills, interests, and career goals.

- The "Find My Career" page uses a machine learning model built with Scikit-learn, Random Forest, and Word2Vec embeddings to provide personalized and accurate career recommendations.
- The model has a high accuracy rate of 97%.

- **Random Forest:**

- The platform utilizes a Random Forest-based classifier for skill matching and career prediction.
- The "Skill Assessment and Learning Plans" feature uses a Random Forest model to predict job roles that align with a user's profile.
- The "Find My Career" page utilizes a Random Forest algorithm, implemented through Scikit-learn.
- The pre-processed data is fed into a Random Forest model, which builds multiple decision trees.

- **Word2Vec Embeddings:**

- The platform utilizes Word2Vec embeddings for skill matching and career prediction.
- The "Skill Assessment and Learning Plans" feature uses Word2Vec embeddings to analyze user skills and recommend appropriate job roles.
- The textual inputs (e.g., key skills) are converted into high-dimensional vector representations using Word2Vec embeddings.
- Tie meaning of skills and their relationships to specific roles, enhancing the model's ability to match user profiles with career paths.

NLP Models

- **Textract:**

- This AI-powered service is used for automated extraction of text and structured data from resumes and job-related documents.

- **PyPDF2 module**

PyPDF2 is a Python library used for working with PDF files. It allows for various operations such as:

- Extracting document information (title, author, etc.)
- Splitting and merging PDF files
- Adding watermarks
- Encrypting and decrypting PDFs
- **Extracting text from PDF files**

Other Models/Techniques used

- The platform incorporates various machine learning models.
- The platform utilizes machine learning and Natural Language Processing (NLP) techniques.
- The platform employs Word2Vec embeddings in the "Skill Assessment and Learning Plans" feature to match user skills with job requirements accurately.
- The platform's "Sia: A Personalized Guide Bot" uses NLP techniques to assist users in navigating the website and understanding its features.
- The platform's "Blogs" feature, supported by Google Firebase, can leverage NLP to organize and recommend relevant blog posts to users.

Chapter 4

System Design

4.1 System Architecture

The system architecture is designed in a layered approach to ensure modularity, maintainability, and scalability. The architecture comprises five main layers:

4.1.1 User Interface (UI) Layer: This top layer is responsible for the presentation and user interaction. It is developed using React.js, HTML5, CSS3, JavaScript, and Bootstrap to create a dynamic and responsive web application. The main components include the Home Page, Explore Page, Chatbot interface, Blogs section, and Profile Section.

4.2.1 AI-Powered Career Guidance Layer: This layer utilizes AI technologies to provide personalized career guidance. Technologies such as Scikit-Learn, XGBoost, and NLP models (BERT, GPT) are employed. Components include the Career Recommendation Engine, Resume-Based Interview Program, and Real-Time Job Market Insights.

4.1.3 Career Exploration Tools Layer: This layer provides tools for users to explore different career options, using machine learning models and career recommendation systems. Key components are the Career Path Exploration tools and Visualization Tools.

4.1.4 Career Resource Portal Layer: This layer serves as a central hub for career-related resources and information. It uses NLP models, data mining, and market trend analysis. Components include Curated Career Resources, Search and Filter Options, Market Trend Analysis, and Educational Pathways information.

4.1.5 Career Mentorship Layer: This layer focuses on providing mentorship and guidance to users, using Chatbot AI. The main components are the Mentor-Student Interaction Portal and Learning Resources.

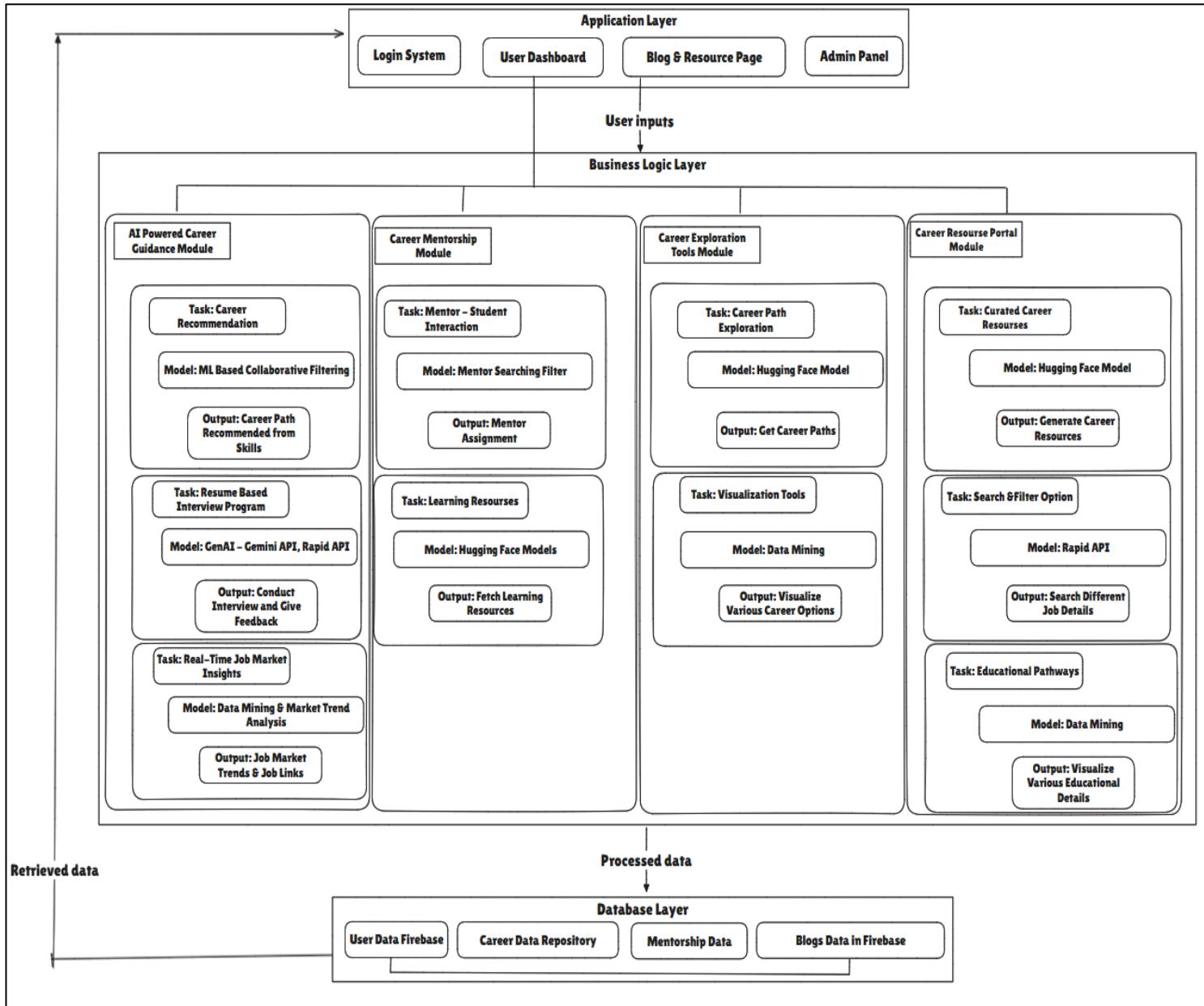


Fig 4.1 System Architecture of ASCEND Website

The layered architecture facilitates modular development, allowing each layer to be updated or expanded independently. This design leverages AI, data mining, and web development frameworks to provide an effective career guidance experience.

4.2 Block Diagram

The block diagram illustrates the major components of the system, categorized into Input, Processing, and Output. This diagram visually represents how the platform handles data, processes it using AI/ML models, and generates personalized career guidance, mentorship, and resource recommendations.

- **Input Components:**

- **User Data:** Students provide personal details, career preferences, skills, interests, and resume data.
- **Mentorship Requests:** Students request guidance, and mentors provide feedback.
- **External Data Sources:** The system fetches real-time job market trends and educational resources from external APIs or databases.

- **Processing Components:**

- **AI-Powered Career Guidance:** This includes collaborative filtering algorithms, ML-based job market analysis, and pathway visualization.
- **Mentorship and Feedback:** Mentor-student matching and feedback analysis.
- **Resource Recommendation Engine:** NLP models and search/filter tools.

- **Output Components:**

- **Career Recommendations:** Display of suitable career paths and visual roadmaps.
- **Mentorship Reports:** Personalized mentorship reports and progress tracking.
- **Educational Resources:** Access to curated articles, courses, certifications, and real-time job trends.

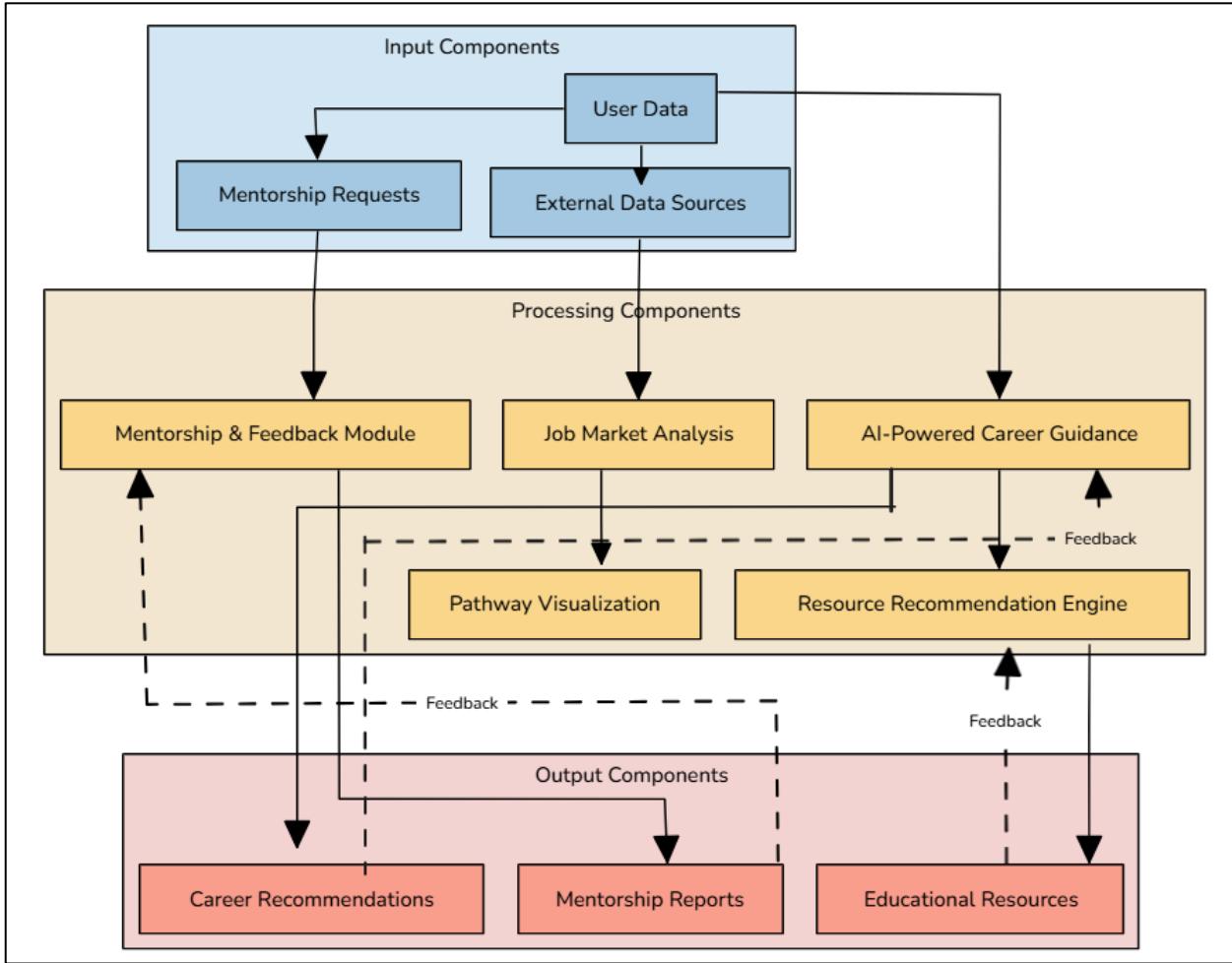


Fig 4.2 Block Diagram of ASCEND Components

4.3 Data Flow Diagrams (DFD)

The Data Flow Diagrams illustrate how data moves through the system, highlighting processes, data stores, and external entities.

- **Level 0: Context Diagram**

At the highest level, the ASCEND platform is represented as a single process interacting with three external entities: **User (Student)**, **Specialized User (Admin/Mentor/External Expert)**, and **External Systems (Firebase, job market databases, learning platforms)**.

- **Student** provides inputs such as personal details, career interests, and mentorship requests.
- **Specialized User** processes mentorship assignments, verifies user data, and provides career guidance.
- **External Systems** supply real-time job market trends, educational content, and store user data.
- The system processes student inputs, generates career recommendations, facilitates mentorship connections, and retrieves relevant job market insights and educational resources.

- **Level 1: Major Processes**

This level expands the system into major functional processes:

1. **User Registration & Authentication**

- Students register by providing personal details.
- Data is validated and stored in Firebase.
- The system authenticates users upon login.

2. **Career Recommendation System**

- Students enter their skills and interests.
- AI analyzes this data and fetches job trends from external APIs.
- Processed recommendations are displayed to the student.

3. **Mentorship Allocation Process**

- Students browse mentors on the mentor connect page.
- A mentorship request is submitted via the contact us page.
- Admin manually assigns a mentor based on availability.
- Mentor provides career guidance.
- Student progress is tracked.

4. Learning Resource Access

- Students explore recommended courses and certifications.
- The system fetches data from external learning platforms.
- Courses are filtered based on student preferences.

- **Level 2: Detailed Data Flow**

At Level 2, each major process is broken down further:

1. User Registration & Authentication

- Student enters details → System verifies input → Data stored in Firebase → Account creation confirmed.

2. Career Recommendation System

- Student inputs skills → System queries job market APIs → AI processes recommendations → Results displayed.

3. Mentorship Allocation Process

- Student selects mentor → Contact request sent → Admin assigns mentor → Mentor notified → Sessions scheduled.

4. Learning Resource Access

- Student searches topics → System fetches learning content → Filters applied → Recommended courses displayed.

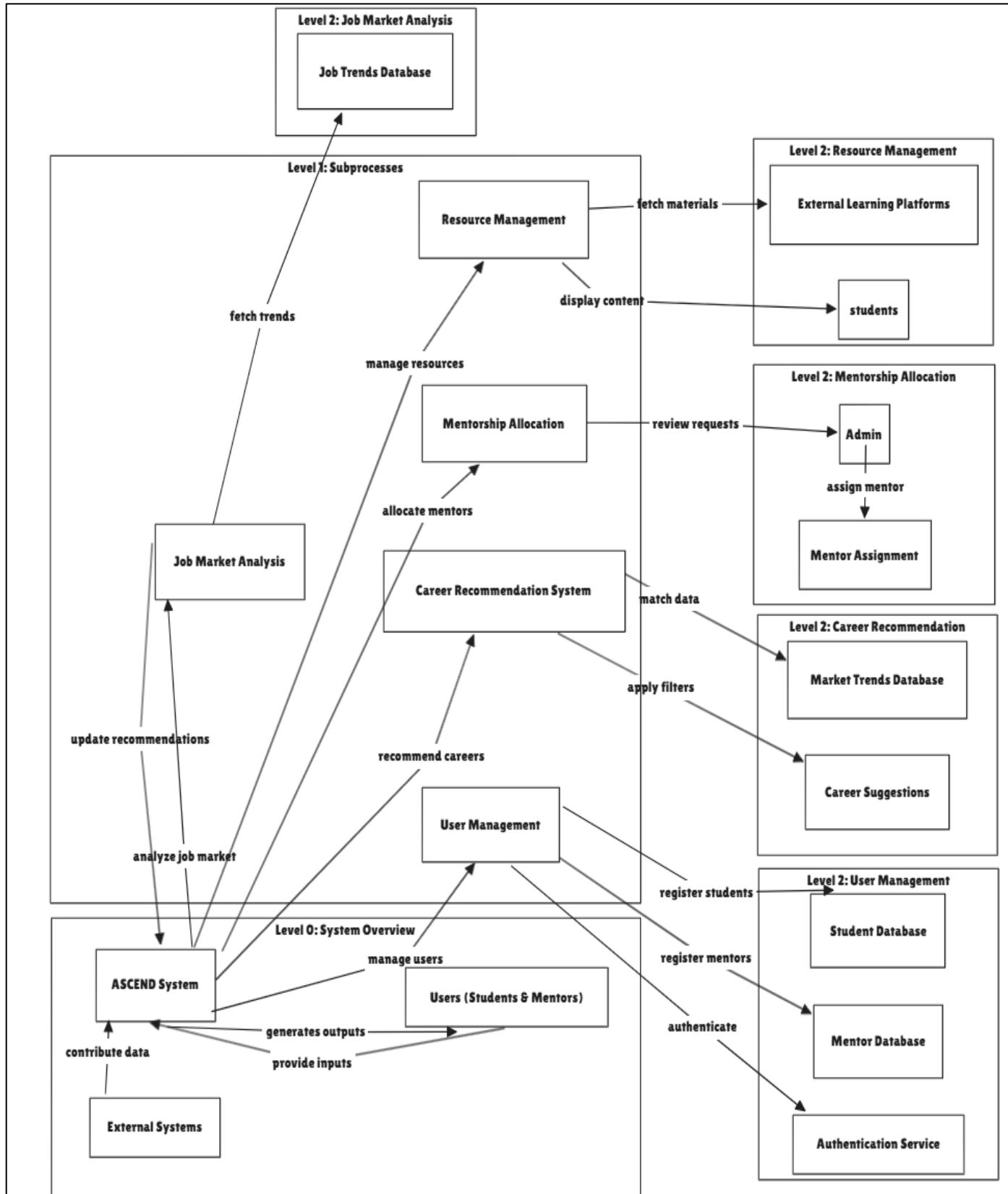


Fig 4.3 Date flow Diagram of ASCEND

4.4 UML Diagrams

- **4.4.1 Use Case Diagram**

1. Actors Involved

The system consists of **three primary actors**:

User (Student):

- The **primary user** who explores career options, receives mentorship, and accesses learning resources.

Specialized User (Admin / Mentor / External Expert):

- Includes **mentors, admins, and industry professionals** who provide **career guidance and content validation**.

External Systems (Firebase & APIs):

- Handles **job market data, educational platforms, resume analysis, and secure user data storage in Firebase**.

2. Key Use Cases

Student Use Cases

Account Management:

- **Register:** Create an account with **profile details**.
- **Login:** Secure **authentication via Firebase**.
- **Manage Profile:** Update **skills, preferences, and career goals**.

Career Exploration:

- **Search Careers:** Find relevant career paths.
- **Receive AI-Powered Recommendations:** View **career suggestions**.
- **Explore Career Roadmaps:** Access skill requirements, certifications, and learning paths.
- **View Job Market Trends:** Get **real-time market insights via APIs**.

Mentorship Interaction:

- **Request Mentorship:** Connect with **mentors** based on career interests.
- **Attend Mentorship Sessions:** Engage in **video or chat-based sessions**.
- **View Mentor Feedback:** Access **personalized career advice**.
- **Track Progress:** View **mentorship reports and skill growth analysis**.

Learning & Resource Access:

- **Explore Learning Resources:** Browse courses, articles, and certifications.
- **Filter Resources:** Utilize **AI-powered filtering options**.
- **Resume-Based Interview Prep:** Receive **AI-generated interview questions** based on uploaded resumes.

Specialized User (Admin / Mentor / External Expert) Use Cases

Mentor & Admin Management:

- **Login & Authentication:** Secure access via **Firebase authentication**.
- **Update Expertise & Availability:** Mentors provide **career guidance**.

Mentorship Operations:

- **Accept Mentorship Requests:** Review and approve **student requests**.
- **Provide Career Guidance:** Share **customized career development plans**.
- **Monitor Student Progress:** Evaluate **skill improvement** and offer feedback.

Market & Resource Management:

- **Validate Career Trends:** Approve **AI-generated career suggestions**.
- **Manage Learning Resources:** Admins maintain **external study materials**.

External System (Firebase & APIs) Use Cases

Job Market & Learning Resource Integration:

- **Fetch Job Market Trends:** Retrieve trending skills and job demand insights.
- **Analyze Market Data:** AI processes job trends & salary insights.
- **Fetch Learning Content:** Retrieve courses, certifications, and guides.
- **Provide AI-Powered Recommendations:** Suggest customized learning plans.

Secure Authentication & Data Storage:

- **Handle User Login:** Firebase authenticates students & mentors.
- **Store Career Preferences & Blogs:** Securely saves user career paths and blog content.

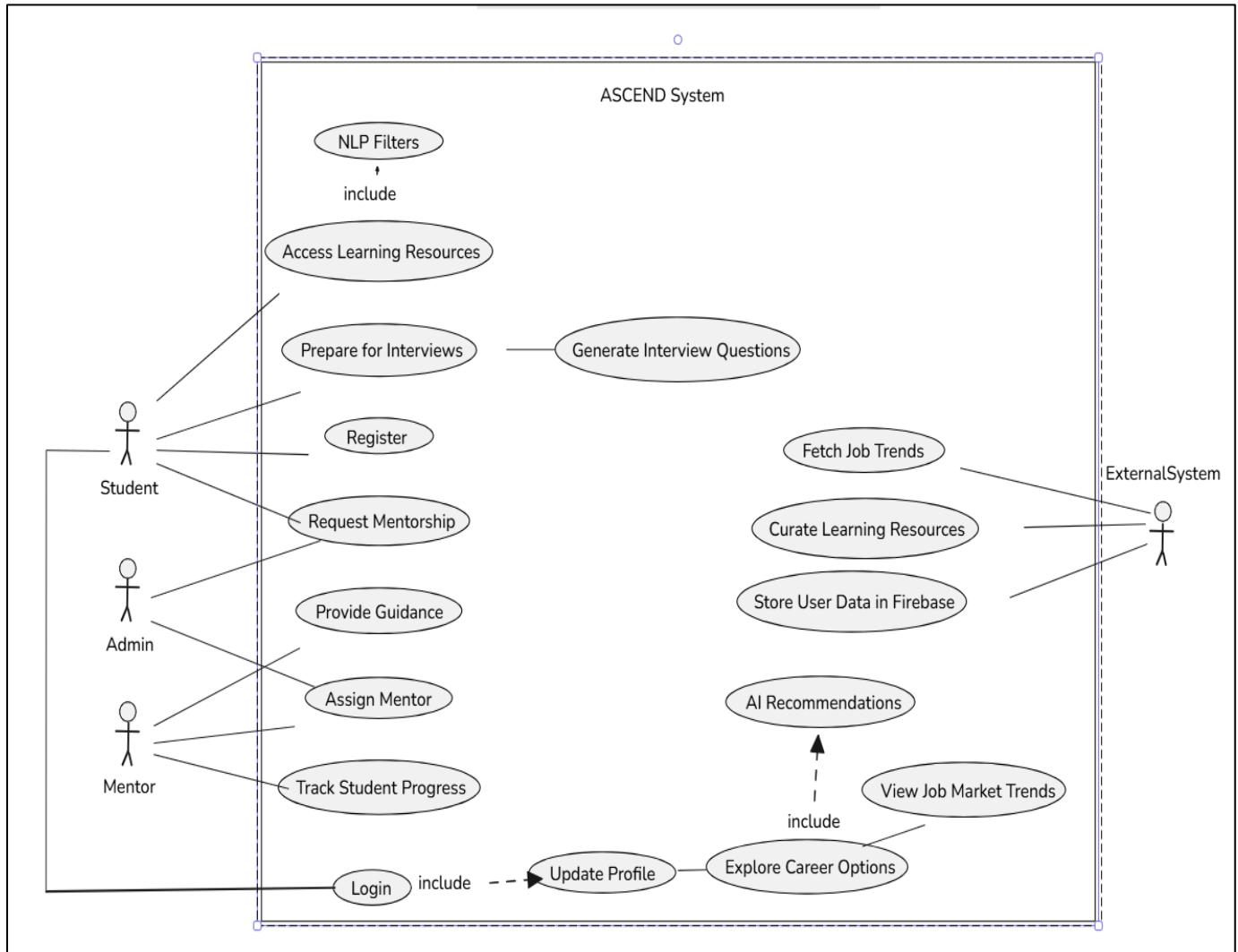


Fig 4.4 Use Case Diagram of ASCEND with actors

3. System Interactions

The **ASCEND system** seamlessly integrates **users, mentors, and external data sources**, ensuring **smooth interaction**.

1. **Students interact** with the ASCEND system for **career exploration, mentorship, and learning resources**.
2. **Mentors/Admins guide** students by **providing career insights, validating job trends, and approving resources**.
3. **External Systems (Firebase & APIs)** provide **real-time job trends, AI-powered recommendations, and authentication**.

- **4.4.2 Class Diagram**

- The **User class** represents students using the platform. It manages user details such as user_id, name, email, skills, and preferences. Users can register, log in, and update their profiles using the methods register(), login(), and update_profile().
- The **CareerRecommendation class** is responsible for managing AI-powered career suggestions tailored to each user's profile. It contains attributes such as recommendation_id, user_id, career_title, skills_required, and market_trend, which help generate personalized career guidance. The method generate_recommendation() analyzes a student's skills and preferences to suggest the most suitable career paths. Additionally, get_market_trend() fetches real-time job market insights, ensuring that recommendations align with industry demands. To help students plan their career growth, the display_roadmap() method provides a structured pathway, outlining necessary skills, certifications, and steps to achieve a chosen career goal.
- The **Mentor class** facilitates career guidance through a structured manual process where students can connect with mentors for professional advice. Initially, students explore available mentors on the **Mentor Connect page**, where they can view mentor details such as expertise, availability, and areas of specialization. Instead of directly initiating a mentorship request, students express their interest by submitting a request through the **Contact Us page**, detailing their career aspirations and preferred mentor.
- Once a request is submitted, the admin manually reviews and processes the request, matching students with suitable mentors based on their chosen field and the mentor's availability. The admin then assigns the mentor to the student, ensuring a well-structured and guided mentorship experience. After allocation, the mentor connects with the student, offering career guidance,

answering queries, and providing feedback through scheduled sessions. Throughout this process, the admin tracks mentorship progress, ensuring that students receive timely responses and relevant career support.

- The MentorshipSession class handles student-mentor interactions, allowing students to seek career guidance. It includes attributes such as session_id, mentor_id, user_id, and feedback, enabling students to schedule mentorship sessions, attend them, and receive personalized feedback. The methods associated with this class include schedule_session(), attend_session(), and view_feedback(). The Mentor class represents professionals who provide career advice and mentorship. It stores details like mentor_id, name, expertise, and availability and provides methods such as accept_request(), provide_feedback(), and track_progress() to assist students in their career journey.

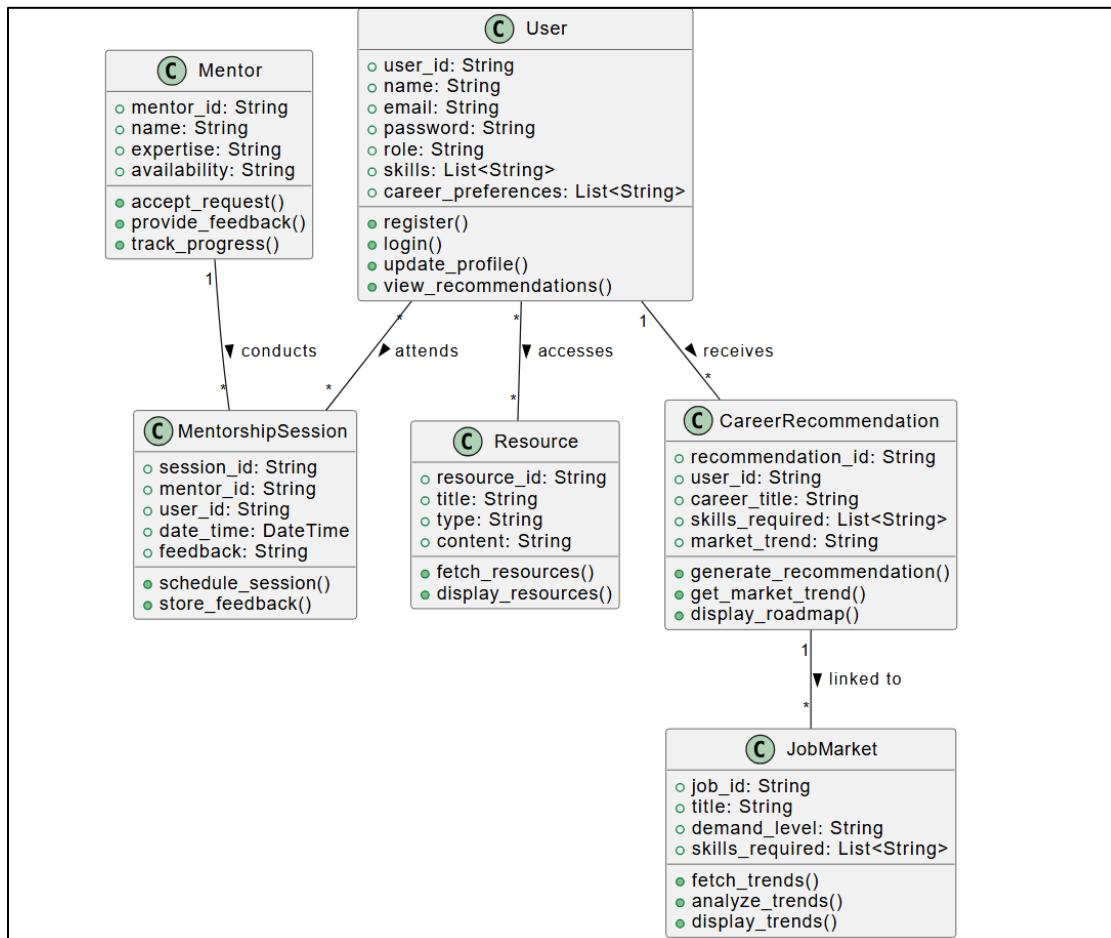


Fig 4.5 Class Diagram of ASCEND Website

- The Resource class manages educational content such as courses and articles, helping students enhance their knowledge. Its attributes include resource_id, title, type, and content, and it provides functionalities such as fetch_resources() and display_resources() to help students access relevant study materials.
- The JobMarket class monitors real-time job market trends, ensuring that career recommendations align with industry demands. It contains attributes like job_id, title, demand_level, and skills_required, and methods like fetch_trends(), analyze_trends(), and display_trends(), which allow the system to provide up-to-date career insights.

2. Relationships

Among the classes, we have identified various relationships between different classes. The ASCEND system establishes multiple relationships between these classes. A **User** can receive multiple career recommendations, creating a **one-to-many relationship** with the **Career Recommendation class**. Similarly, a **User** can attend multiple mentorship sessions, while each session may have multiple users, forming a **many-to-many relationship** between the **User** and **Mentorship Session** classes. Each **Mentor** can conduct multiple mentorship sessions, leading to a **one-to-many relationship** between the **Mentor** and **Mentorship Session** classes. Users can access various learning resources, creating a **many-to-many relationship** with the **Resource class**. Lastly, each **Career Recommendation** is linked to job market trends, ensuring relevance to current industry demands, forming a **one-to-many relationship** between the **Career Recommendation** and **Job Market** classes.

- **User ↔ CareerRecommendation:**
 - One-to-Many: Users receive multiple career suggestions.
- **User ↔ MentorshipSession:**
 - Many-to-Many: Users attend multiple sessions.
- **Mentor ↔ MentorshipSession:**
 - One-to-Many: Mentors conduct multiple sessions.
- **User ↔ Resource:**
 - Many-to-Many: Users access various learning resources.
- **CareerRecommendation ↔ JobMarket:**
 - One-to-Many: Recommendations are linked to job trends.

- **4.4.3 Sequence Diagram**
 - The Sequence Diagram illustrates the process execution order and component interactions over time.
 - **Key Participants:** Student, ASCEND Platform, Mentor, Job Market API, and Resource Module.
 - **Main Sequences:**
- **Sequence 1: Student Registration and Login:** Student initiates registration, ASCEND stores user details, ASCEND sends confirmation, Student logs in, ASCEND verifies credentials, and ASCEND grants access.
- **Sequence 2: Career Recommendation Generation:** Student submits data, ASCEND requests job trends from API, API returns insights, ASCEND processes data, AI Engine sends recommendations, and ASCEND displays career paths.
- **Sequence 3: Mentorship Request and Feedback:** Student sends request, ASCEND notifies mentor, Mentor accepts, ASCEND schedules session, Student and Mentor interact, Mentor provides feedback, ASCEND stores feedback, and ASCEND displays mentorship report.
- **Sequence 4: Resource Retrieval:** Student requests resources, ASCEND searches Resource Module, Resource Module returns content, and ASCEND displays resources.

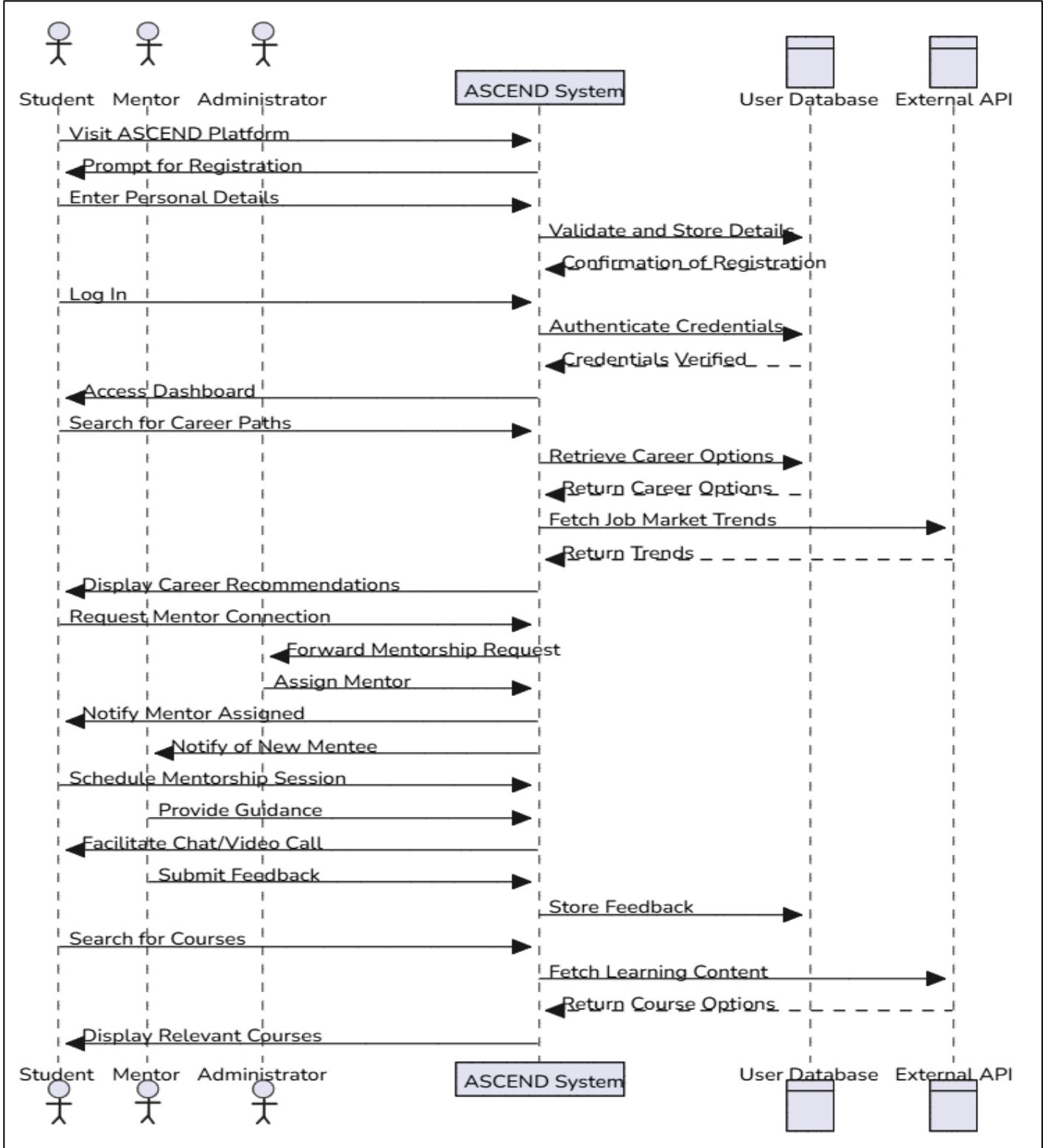


Fig 4.6 Sequence Diagram for various sequences in website

- **4.4.4 Activity Diagram**

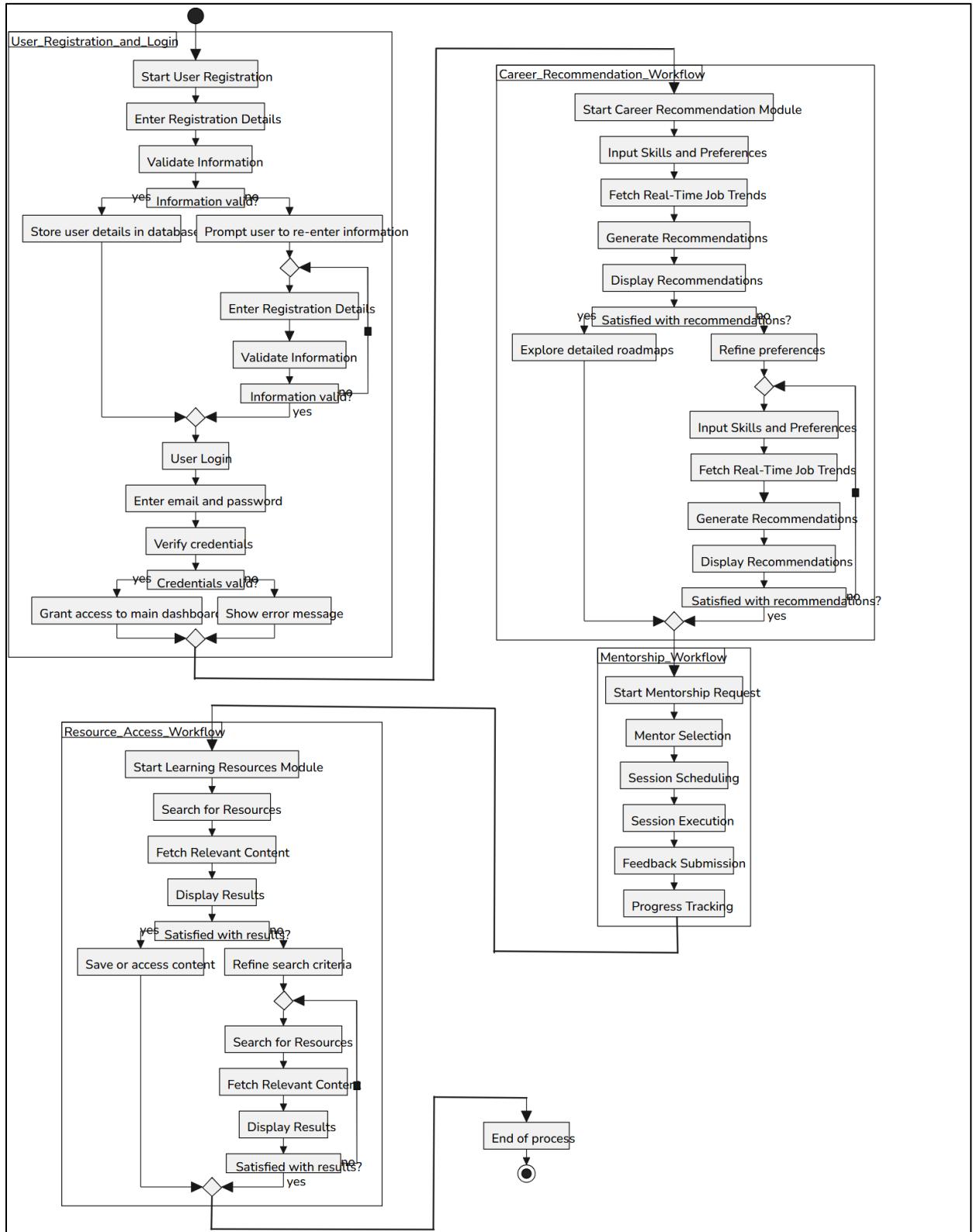


Fig 4.7 Activity Diagram illustrates the workflow and decision-making processes

Workflow Components: Start Node, Activities, Decisions, Fork/Join Nodes, and End Node.

- **Main Activities:**

- **Activity 1: User Registration and Login:** Start, Enter Registration Details, Validate Information, User Login, and End.
- **Activity 2: Career Recommendation Workflow:** Start, Input Skills and Preferences, Fetch Real-Time Job Trends, Generate Recommendations, Display Recommendations, Decision Node, and End.
- **Activity 3: Mentorship Workflow:** Start, Mentor Selection, Session Scheduling, Session Execution, Feedback Submission, Progress Tracking, and End.
- **Activity 4: Resource Access Workflow:** Start, Search for Resources, Fetch Relevant Content, Display Results, Decision Node, and End.

4.5 Database Design

- **4.5.1 ER Diagram**

- The ER Diagram illustrates the relationships between key entities in the system.
- **Key Entities and Attributes:**
 - **Student:** Primary Key (student_id), Attributes (name, email, password, skills, preferences).
 - **Mentor:** Primary Key (mentor_id), Attributes (name, expertise, availability, email).
 - **Career Recommendation:** Primary Key (recommendation_id), Attributes (career_title, skills_required, market_trend), Foreign Key (student_id).
 - **Mentorship Session:** Primary Key (session_id), Attributes (date_time, feedback), Foreign Keys (student_id, mentor_id).
 - **Resource:** Primary Key (resource_id), Attributes (title, type, content).
 - **Job Market:** Primary Key (job_id), Attributes (title, demand_level, skills_required).

- Relationships Between Entities:

- Student ↔ CareerRecommendation (One-to-Many).
- Student ↔ MentorshipSession (Many-to-Many).
- Mentor ↔ MentorshipSession (One-to-Many).
- Student ↔ Resource (Many-to-Many).
- CareerRecommendation ↔ JobMarket (One-to-One).

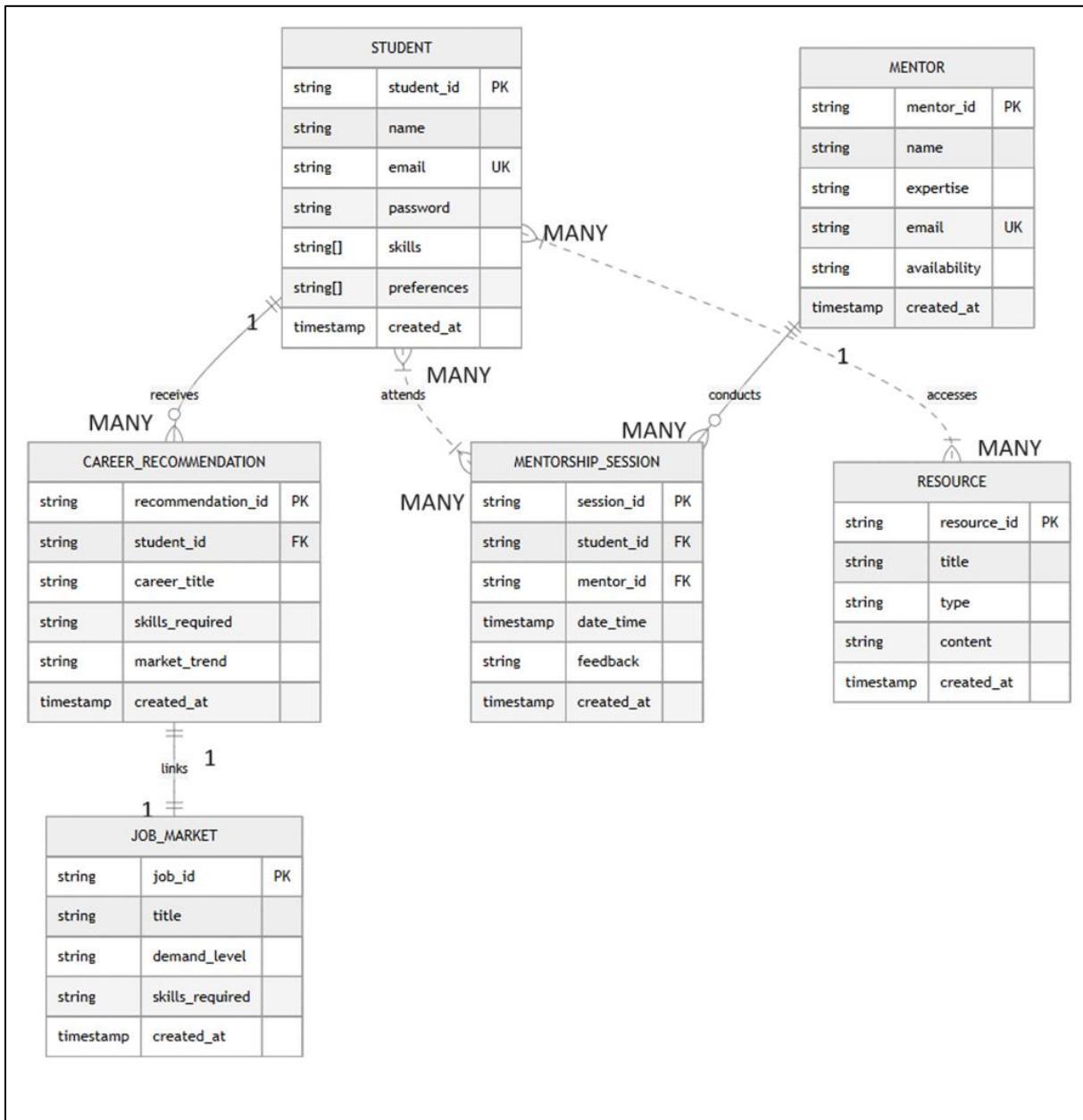


Fig 4.8 ER Diagram

4.5.2 Schema Design

- System Workflow and Data Flow:

1. Student Registration and Profile Setup: Student registers and creates a profile.
2. Career Recommendations: Platform generates personalized career paths.
3. Mentorship Interaction: Students book sessions with mentors, and the system tracks feedback.
4. Resource Access: Students explore educational content.
5. Job Market Trends: Real-time job trends are linked to career recommendations.

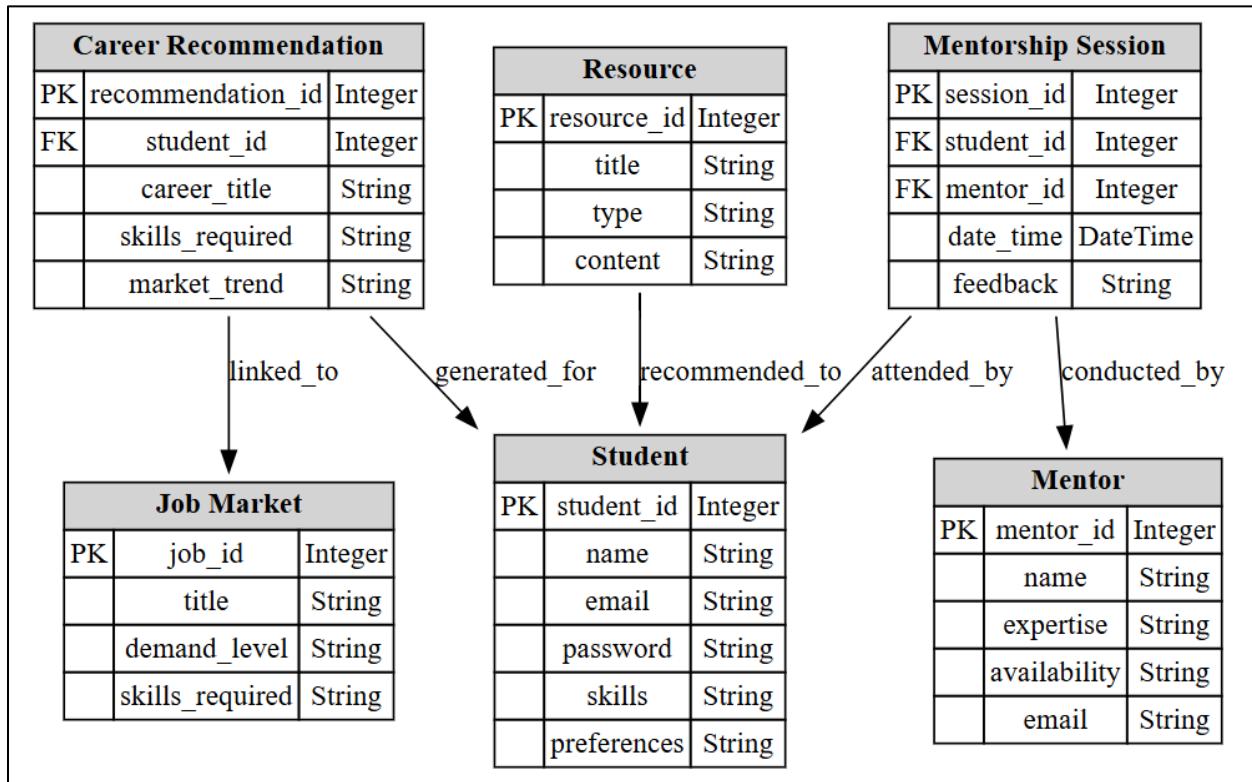


Fig 4.9 Schema Diagram

Chapter 5

Implementation

5.1 Programming Languages and Technologies Used

The AI-driven career exploration platform leverages a combination of programming languages, frameworks, libraries, and technologies to ensure efficient development, robust functionality, and a seamless user experience.

5.1.1 Backend Development

- **Python:** Serves as the primary language for backend development. Its versatility and extensive libraries make it suitable for various tasks, including data processing, machine learning model implementation, and API interactions. Python's readability and ease of use facilitate rapid development and maintainability. 

```
def search_jobs_with_jsearch(keywords):
    """Searches for jobs with Rapid JSearch API."""
    url = "https://jsearch.p.rapidapi.com/search"
    querystring = {"query": " ".join(keywords), "num_pages": "1"}
    headers = {
        "X-RapidAPI-Key": JSEARCH_API_KEY,
        "X-RapidAPI-Host": JSEARCH_API_HOST,
    }
    try:
        response = requests.get(url, headers=headers, params=querystring)
        response.raise_for_status() # Raise HTTPError for bad responses (4xx or 5xx)
        print(response.json().get('data', []))
        return response.json().get('data', [])
    except requests.exceptions.RequestException as e:
        return [f"Error fetching jobs: {e}"]
```

Fig: 5.1 Usage of Python Functions to search for Jobs with Keywords

- **Flask:** A lightweight and flexible Python web framework. It's used to create RESTful APIs that handle communication between the frontend and backend. Flask's simplicity and modularity allow for efficient development of web services that manage data exchange and application logic.

```

load_dotenv()

app = Flask(__name__)
app.secret_key = os.getenv("SECRET_KEY")

#-----Routes-----
@app.route('/')
def index():
    return render_template('index.html')

@app.route('/login')
def login():
    return render_template('../auth/login.html')

@app.route('/signup')
def signup():
    return render_template('../auth/signup.html')

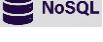
```

Fig: 5.2 Usage of Flask to manage @app.routes(' ') and functions

5.1.2. Frontend Development

- **HTML5:** Used for structuring the content of web pages. 
- **CSS3:** Handles the visual presentation, and styling of the web pages. 
- **JavaScript:** Enables dynamic behaviour and interactivity on the frontend of the platform. 
- **Bootstrap:** A CSS framework that simplifies the design and development of responsive web interfaces. It provides pre-designed components and styling, making it easier to create visually appealing and user-friendly layouts. 

5.1.3. Database

- **NoSQL Database:** A NoSQL database is employed for flexible and scalable data storage and retrieval. This type of database is well-suited for handling diverse data structures, including user data, job information, system configurations, and other application data. NoSQL databases provide high availability and scalability, allowing for efficient data management. 
- **Google Firebase:** Used for authentication and data storage of user login details and blogs posted. 

5.1.4. AI/ML Components

- **Tensorflow:** Developed by Google, TensorFlow is a powerful open-source machine learning framework. It's used for building and training the machine learning models that power the career recommendation engine and other AI-driven features. TensorFlow enables efficient computation and deployment of complex models. 
- **Word2Vec:** A technique for natural language processing (NLP). It's employed for skill matching and semantic analysis by analysing textual data, such as job descriptions and resumes, to identify relevant skills and match them to user profiles. This technology enhances the accuracy of career recommendations and improves the platform's understanding of user skills.
- **Hugging Face:** A platform providing access to various pre-trained models and libraries.
 - **Transformer Models (e.g., BERT, GPT, T5):** Used for natural language processing tasks.
 - Transformers library: Python library for working with Transformer models.

5.1.5. Other Technologies

- **Chart.js:** A JavaScript library used for creating charts and graphs to visualize data.
- **RapidAPI:** For real-time job and market trends.
- **News API:** For market trends.
- **Wiki API:** For startup details.
- **PyPDF2 module**
- **python-docx**
- **joblib**
- **dotenv**
- **requests**
- **Werkzeug**
- **Google Gemini API:** A generative AI service used in this project to power resume analysis, interview question generation, answer evaluation, and chatbot responses.

5.2 Development Tools and Environments

The development process utilizes a range of tools and environments to facilitate collaboration, enhance productivity, and ensure code quality throughout the project lifecycle.

- **IDEs (Integrated Development Environments):**

There are various IDE's like VS Code, Pycharm, Spyder, Jupyter Notebooks used to run and develop the project in the initial stage to run the server in local system to identify errors and modify the code and again test the project. From these IDE's we have used VS Code to develop and run our project in local server.

- VS Code (Visual Studio Code): VS Code is a powerful and extensible code editor that supports various programming languages and development workflows. It provides features such as code completion, debugging, Git integration, and a rich ecosystem of extensions, making it a comprehensive environment for coding and project management.

- **Version Control:** Git is a distributed version control system used for tracking changes in source code during software development. It enables collaboration among developers, facilitates code management, and allows for easy branching and merging of code changes. Platforms like GitHub or GitLab are often used to host Git repositories.

- **Development Server:** Flask built-in development server

- **Database Management:** NoSQL Workbench

- **API Testing:** Selenium

- **Browser Developer Tools:** Chrome DevTools

- **Package Management:** pip with requirements.txt

- **Deployment:** Configured for deployment on web servers for Google Cloud Platform

- **Virtual Environment:** Python venv for dependency isolation

5.3 Module-Wise Implementation Details

The ASCEND platform is structured into distinct modules, each designed to provide specific functionalities for career exploration and guidance. The architecture is organized into three main layers: the Application Layer, Business Logic Layer, and Database Layer.

1. Application Layer

- **Login System:** This module manages user authentication and authorization, ensuring secure access to the platform's features.
- **User Dashboard:** Provides a personalized overview of the user's career exploration journey, including saved searches, recommended resources, and progress tracking.
- **Blog & Resource Page:** This section allows users to access and contribute to a repository of career-related articles, guides, and other helpful materials.
- **Admin Panel:** Provides administrative tools for managing content, user accounts, and platform settings.

2. Business Logic Layer

This layer houses the core functionalities and AI-driven modules that process user inputs and deliver relevant outputs.

- **AI-Powered Career Guidance Module:**
 - **Career Recommendation:** Utilizes Machine Learning-based Collaborative Filtering to recommend career paths based on user skills.
 - **Resume-Based Interview Program:** Employs the Gemini API and Rapid API to conduct simulated interviews based on uploaded resumes and provides feedback.
 - **Real-Time Job Market Insights:** Uses Data Mining and Market Trend Analysis to provide insights into current job market trends and relevant job links.
- **Career Mentorship Module:**
 - **Mentor-Student Interaction:** Facilitates communication and interaction between mentors and students through a Mentor Searching Filter.
 - **Learning Resources:** Recommends learning resources using Hugging Face Models.

- **Career Exploration Tools Module:**
 - **Career Path Exploration:** Uses Hugging Face Models to help users explore potential career paths.
 - **Visualization Tools:** Leverages Data Mining to visualize various career options.
- **Career Resource Portal Module:**
 - **Curated Career Resources:** Generates career resources using Hugging Face Models.
 - **Search & Filter Options:** Provides search and filtering capabilities using Rapid API.
 - **Educational Pathways:** Visualizes various educational pathways using Data Mining.

3. Database Layer

- **User Data Firebase:** Stores user-related data, including profiles, preferences, and activity logs.
- **Career Data Repository:** Houses a comprehensive database of career information, job descriptions, and industry trends.
- **Mentorship Data:** Manages data related to mentor-student interactions and mentorship programs.
- **Blogs Data in Firebase:** Stores and manages blog content and user-generated articles.

Data Flow

The diagram illustrates the flow of data through the system:

- **User Inputs:** Users interact with the platform through the Application Layer, providing data and queries.
- **Retrieved Data:** The Business Logic Layer retrieves data from external sources and the Database Layer.
- **Processed Data:** The Business Logic Layer processes the retrieved data using AI models and algorithms.
- **Output:** The processed data is presented to the user through the Application Layer.

Key Technologies

The platform leverages various technologies, including:

- **Machine Learning (ML) Models:** For career recommendations, skill matching, and personalized learning plans.
- **Natural Language Processing (NLP) Models:** For resume analysis, interview simulations, and resource generation.
- **Generative AI (GenAI) - Gemini API:** For advanced interview simulations and feedback.
- **Rapid API:** For job searching and filtering.
- **Hugging Face Models:** For career path exploration and resource generation.
- **Data Mining:** For market trend analysis, visualization, and educational pathway mapping.
- **Firebase:** For user data and blog data storage.

5.4 Algorithms and Logic Used

The platform employs a combination of machine learning algorithms, natural language processing techniques, and logical structures to deliver its core functionalities and ensure intelligent and personalized user experiences.

- **Random Forest:** Random Forest is a supervised learning algorithm used for career path prediction and classification tasks. It operates by constructing a multitude of decision trees during training and outputs the class that is the mode of the classes (classification) or the mean prediction (regression) of the individual trees. In this platform, it analyzes user data, such as skills, experience, and educational background, to predict suitable job roles and career paths.
- **Word2Vec:** Word2Vec is a technique for natural language processing (NLP) that is used for skill matching, semantic analysis, and text-based recommendations. It generates word embeddings, which are vector representations of words that capture their semantic relationships. This technique analyzes textual data, such as job descriptions, resumes, and user profiles, to identify relevant skills, match them to user profiles, and provide contextually relevant recommendations.
- **Gemini API Integration:** The platform integrates with the Gemini API to enhance its capabilities in areas such as resume analysis and interview preparation. The Gemini API can be used to analyze user resumes, extract key information, and generate relevant interview questions.

It can also provide feedback on user responses and simulate interview scenarios to help users prepare for job interviews.

Models/ Embeddings	Tasks for Models/ Embeddings	Train-Test Split	Dataset origin	Dataset size/ records	Accuracy
Random Forest	Categorize data and predict Suitable output	70-30	Kaggle originated	56k records *5	96%
Word2Vec	Convert English input to decimal format	70-30	NA	NA	NA
Google Gemini API	Text Generation	NA	Web-scale data	NA	NA
TensorFlow/Keras	Intent Classification for Chatbot	80-20	Words.pkl Classes.pkl Intents.json	1kb 1kb 7kb	87%
BOW – Bag of Words Embeddings	Feature extraction for intents classification	80-20	Words.pkl Intents.json	1kb 7kb	NA

Table 1: Algorithms and Logic Used

Chapter 6

Testing and Results

6.1 Testing Methodologies

The platform underwent rigorous testing at various levels to ensure reliability, functionality, and performance. The following testing methodologies were employed:

- **6.1.1 Unit Testing:** Unit testing involves testing individual modules or components of the platform in isolation. This approach verifies that each unit of code functions as intended. For example, unit tests were written to validate the functionality of the user authentication module, ensuring that user registration, login, and profile updates work correctly. Python's PyTest framework was utilized to write and execute unit tests, ensuring each function and class performed as expected.

Program on Unit Testing to test various features in the website using selenium testing script

```
import unittest

from selenium import webdriver

from selenium.webdriver.common.by import By

from selenium.webdriver.chrome.service import Service as ChromeService

from webdriver_manager.chrome import ChromeDriverManager

from selenium.webdriver.support.ui import WebDriverWait

from selenium.webdriver.support import expected_conditions as EC

class TestJobFinderSearch(unittest.TestCase):

    def setUp(self):

        # Set up the Chrome driver
```

```
service = ChromeService(ChromeDriverManager().install())

self.driver = webdriver.Chrome(service=service)

self.driver.get("http://Ascend-vviti/") # 34.121.70.65:7860

self.driver.implicitly_wait(10) # Waiting time - 10 seconds for elements to load

def tearDown(self):

    self.driver.quit()

def test_job_search_by_keyword(self):

    # 1. Locate the search bar and button

    search_bar = self.driver.find_element(By.ID, "query")

    search_button = self.driver.find_element(By.CLASS_NAME, "search-button")

    # 2. Enter a job title and click the search button

    search_bar.send_keys("Software Engineer")

    search_button.click()

    # 3. Verify that job results are displayed

    results_container = self.driver.find_element(By.ID, "results")

    self.assertTrue(results_container.is_displayed())
```

```
# 4. Verify that at least one job item is displayed

job_items = self.driver.find_elements(By.CLASS_NAME, "job-item")

self.assertGreater(len(job_items), 0)
```

```
# 5. Verify that the job titles contain the search keyword
```

```
for job_item in job_items:
```

```
    job_title_element = job_item.find_element(By.TAG_NAME, "h3")
```

```
    job_title = job_title_element.text.lower()
```

```
    self.assertIn("software engineer", job_title)
```

```
if __name__ == "__main__":
```

```
    unittest.main()
```

- **6.1.2 Integration Testing:** Integration testing focuses on testing the interactions between different modules or components. This verifies that the modules work together seamlessly. For instance, integration tests were conducted to ensure that the career recommendation module correctly interacts with the user authentication module to retrieve user data and provide personalized recommendations.
- **6.1.3 System Testing:** System testing evaluates the entire platform as a whole to ensure that it meets the specified requirements. This includes testing the platform's functionality, performance, security, and usability. Selenium was used to automate browser interactions and simulate user workflows, ensuring that the platform functions correctly from end to end.

6.2 Test Cases and Reports

Comprehensive test cases were designed and executed to cover various aspects of the platform's functionality. Each test case includes the following:

- Test ID: A unique identifier for the test case.
- Test Description: A brief description of the functionality being tested.
- Test Inputs: The data or actions used as input for the test.
- Expected Outputs: The expected results or behavior of the system.
- Actual Results: The actual results obtained during testing.
- Status: Whether the test case passed or failed.

6.2.1 Unit Test Cases – MentorBot Report:

Test case ID	Module	Test Description	Expected Output	Actual output	Result
UT-CB-001	MentorBot	Bot Greeting	Welcome message	Welcome message	Pass
UT-CB-002	MentorBot	Resume Tips	Relevant tips	Relevant tips	Pass
UT-CB-003	MentorBot	Invalid Query	Error message	Error message	Pass
UT-CB-004	MentorBot	Job Search Help	Job Search Guidance	Job Search Guidance	Pass
UT-CB-005	MentorBot	Interview Prep	Interview advice	Interview advice	Pass

Table 2: Test case report for Mentor Bot output

6.2.2 Unit Test Cases – JobFinder Report:

Test case ID	Module	Test Description	Expected Output	Actual output	Result
UT-JF-001	JobFinder	Keyword Search	Relevant jobs	Relevant jobs	Pass
UT-JF-002	JobFinder	Location Search	Jobs in location	Jobs in location	Pass
UT-JF-003	JobFinder	No Results	Empty list/message	Empty list/message	Pass
UT-JF-004	JobFinder	Filter by Experience	Filtered job list	Filtered job list	Pass
UT-JF-005	JobFinder	Sort by Date	Sorted job list	Sorted job list	Pass

Table 3: Test case report for Job Finder output

6.2.3 Unit Test Cases – Skill Assessment Report:

Test case ID	Module	Test Description	Expected Output	Actual output	Result
UT-SA-001	SkillAssessment	Recommend Roles	Relevant roles	Relevant roles	Pass
UT- SA-002	SkillAssessment	No Matching Roles	Other roles	Other roles	Pass
UT- SA-003	SkillAssessment	Skill Levels	Roles for skill level	Roles for skill level	Pass
UT- SA-004	SkillAssessment	Skill Weighting	Weighted role ranking	Weighted role ranking	Pass

Table 4: Test case report for Skill Assessment Report output

Test reports were generated to document the test results, including any defects or issues identified. These reports provide valuable information for identifying and resolving problems, ensuring the platform's quality and stability.

6.3 Performance Evaluation

The performance of the AI-driven career exploration platform was evaluated to assess its efficiency and effectiveness. This evaluation included comparing the platform's accuracy, speed, and precision with existing models or benchmarks.

```

  def preprocess_input(input_text):
    # Preprocess the input text
    tokenized_input = input_text.split()
    input_embeddings = get_embeddings(tokenized_input)
    return input_embeddings

  def predict_role(input_text):
    # Preprocess input
    input_embeddings = preprocess_input(input_text)

    # Make prediction
    predicted_role = rf_model.predict([input_embeddings])
    return predicted_role[0]

  # Get user input for industry type, department, role category, and key skills
  industry_type = input("Enter industry type: ")
  department = input("Enter department: ")
  role_category = input("Enter role category: ")
  key_skills = input("Enter key skills: ")

  # Concatenate the inputs
  user_input = industry_type + ' ' + department + ' ' + role_category + ' ' + key_skills

  # Predict role
  predicted_role = predict_role(user_input)
  print("Predicted role:", predicted_role)

  ↵ Enter industry type: accounting / auditing
  Enter department: finance & accounting
  Enter role category: accounting & taxation
  Enter key skills: ['tcs', 'accounting', 'finance', 'auditing', 'financial statements', 'fresher', 'pf', 'gst', 'stock inventory', 'cash flow']
  Predicted role: accountant / accounts executive
  /usr/local/lib/python3.11/dist-packages/scikit-learn/utils/validation.py:2739: UserWarning: X does not have valid feature names, but RandomForestClassifier was fitted with feature names
  warnings.warn(

```

Fig 6.1: Predicting job role based on user input

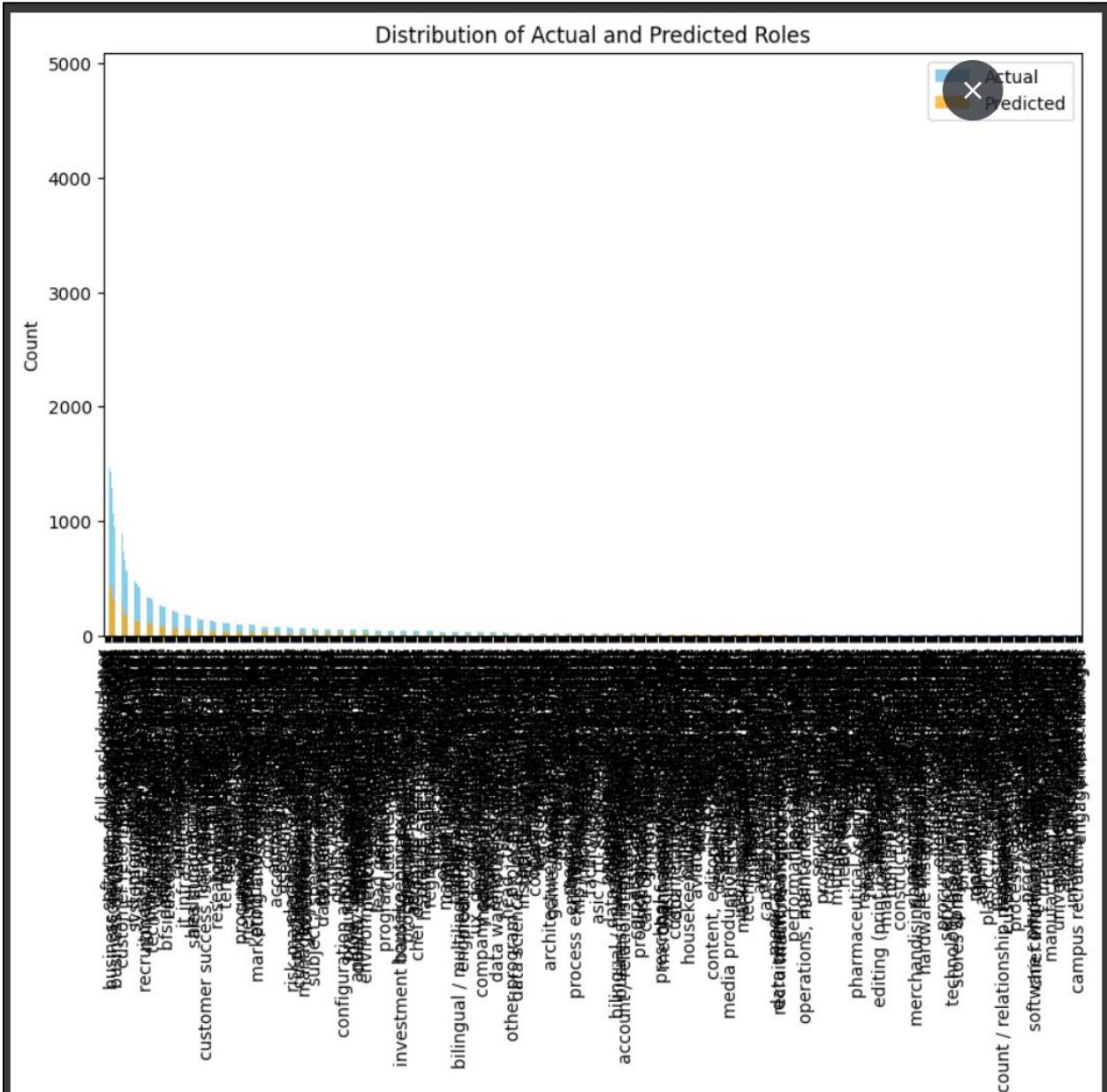


Fig 6.2: Distribution of actual and predicted roles with roles and count as labels

Accuracy:

- This is the most basic metric, representing the overall correctness of the model's predictions.
- **Definition:** $(\text{Number of correct predictions}) / (\text{Total number of predictions})$
- **Relevance:** While important, high accuracy doesn't always mean the model is perfect, especially if the dataset is imbalanced (i.e., some career categories are much more frequent than others).

Speed/Efficiency:

- This refers to how long it takes the model to make predictions.
- **Definition:** Time taken to predict a single instance or a batch of instances.
- **Relevance:** Important for real-time applications. If your model takes 10 seconds to predict a career, it might not be a good user experience.

Precision:

- Precision focuses on how often the model is correct when it *predicts* a specific career.
- **Definition:** (Number of true positives for a career) / (Number of times the model predicted that career)
- **Relevance:** High precision is important when you want to be confident in the model's positive predictions. For example, if the model predicts "Data Scientist," you want it to be right most of the time.

```
[ ] recall = recall_score(y_test, y_pred, average='weighted') # Weighted average for multi-class problems
print("Recall Score:", recall)

# F1 Score
f1 = f1_score(y_test, y_pred, average='weighted') # Weighted average for multi-class problems
print("F1 Score:", f1)

→ Train Accuracy: 0.9966294128082314
Test Accuracy: 0.969546449056827
Precision Score: 0.9706287094929578
Recall Score: 0.969546449056827
F1 Score: 0.968480375714373
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565: UndefinedMetricWarning: Precision is ill-defined and being set to 0.
    _warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))

[ ] # Evaluate model performance (e.g., using accuracy)
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)

→ Accuracy: 0.969546449056827

→ # Visualize the distribution of predicted roles
```

Fig 6.3: Accuracy and Score of the Model Performance

TensorBoard was utilized to visualize and analyze performance metrics, providing insights into the platform's efficiency and identifying areas for optimization.

6.4 Screenshots of Proposed System

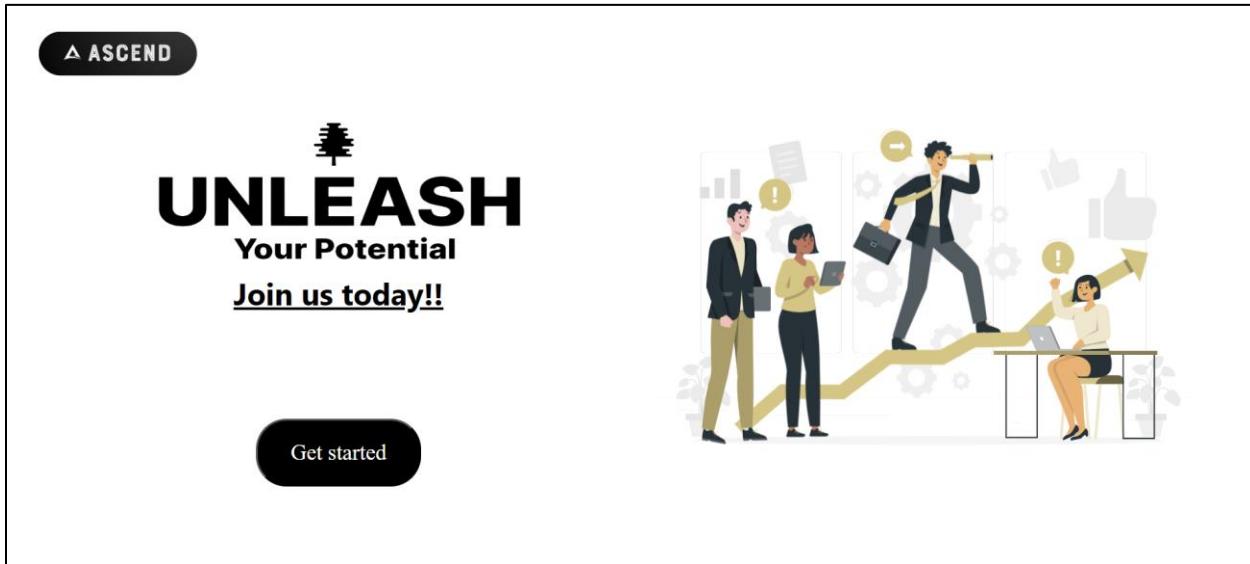


Fig 6.4: Index Page of the website

User Registration and Sign in page:

The image shows two versions of a registration form side-by-side. Both forms have a header "Create an Account" and a "Sign up to continue" link. They include fields for "Full Name" (with placeholder "New User"), "Email" (with placeholder "Newuser@gmail.com"), and "Password" (with placeholder "....."). Each form has a "Sign Up" button at the bottom. The left form has a "G Sign up with Google" button. The right form has a "Sign up with Google" button with a "G" icon. At the bottom of both forms is a link "Already have an account? Log in". Above the right form is a dark overlay with white text: "127.0.0.1:7860 says" followed by "Verification email sent! Please check your inbox and verify your email before logging in." A blue "OK" button is in the bottom right corner of this overlay.

Fig 6.5: Signup Page and Verification Notification

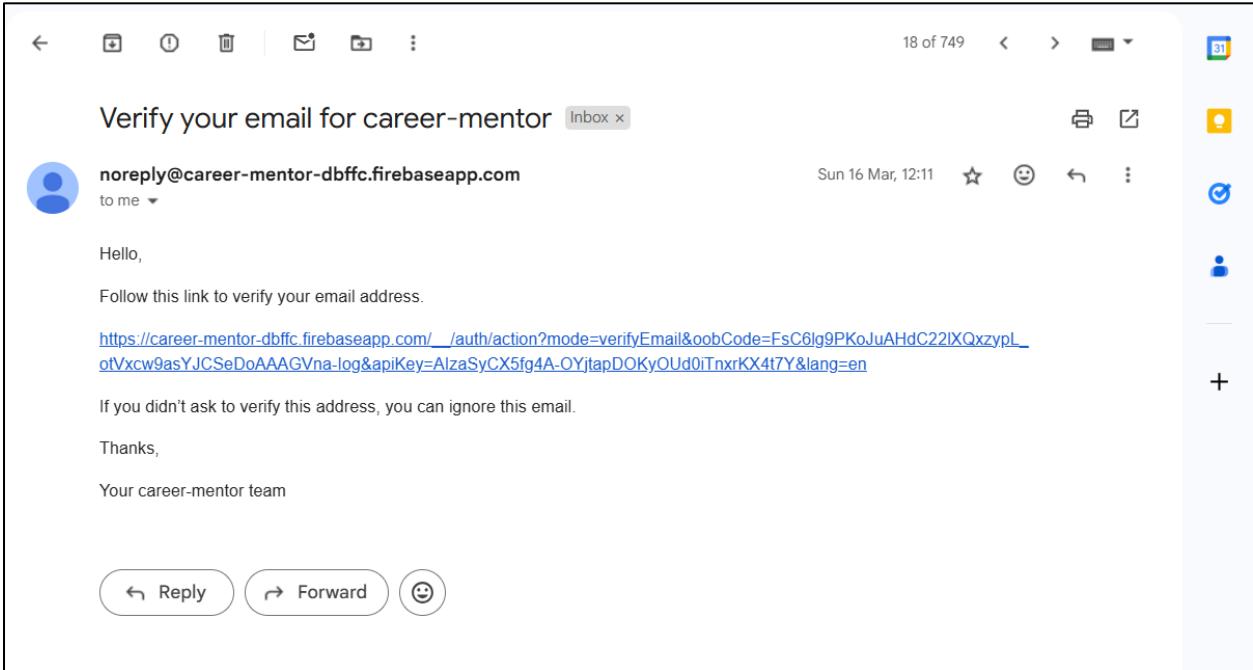


Fig 6.6: Verification user email address using firebase link

The User Signup page provides a straightforward interface for new users to create an account on the ASCEND platform. This process is essential for users to access personalized features, save their progress, and fully utilize the career guidance resources available. The page includes fields for the user's full name, email address, and password. To ensure the validity of user accounts and enhance security, a verification email is sent to the provided email address upon successful signup. Users are required to verify their email before they can log in to the platform.

Working:

1. **User Interaction:** A new user navigates to the "Create an Account" page.
2. **Information Input:** The user enters their full name, desired email address, and a secure password into the respective fields.
3. **Signup Action:** The user clicks either the "Sign Up" button or the "Sign up with Google" button.
 - Clicking "Sign up with Google" initiates the Google authentication process.
 - Clicking "Sign Up" triggers the platform's internal account creation process.
4. **Verification Email:** Upon successful submission of the signup form (via the "Sign Up" button), the system:

- Creates a new user account in the backend database with a status indicating that the email is not yet verified.
 - Generates a unique verification link associated with the provided email address.
 - Sends an email containing this verification link to the email address entered by the user.
5. **Pop-up Notification:** Simultaneously, a pop-up notification ("Verification email sent! Please check your inbox and verify your email before logging in.") is displayed to the user on the signup page, informing them of the next step.
6. **Confirmation:** The user must then check their email inbox, locate the verification email from ASCEND, and click on the provided verification link.
7. **Email Verification:** Clicking the verification link redirects the user back to the ASCEND platform, where their email address is marked as verified in the database.
8. **Redirection:** After the user clicks the "OK" button on the pop-up notification, they are automatically redirected to the Sign In page, where they can now log in with their newly created and verified credentials.

This email verification process is a crucial security measure that helps prevent spam accounts and ensures that users have access to the email address they used for registration.

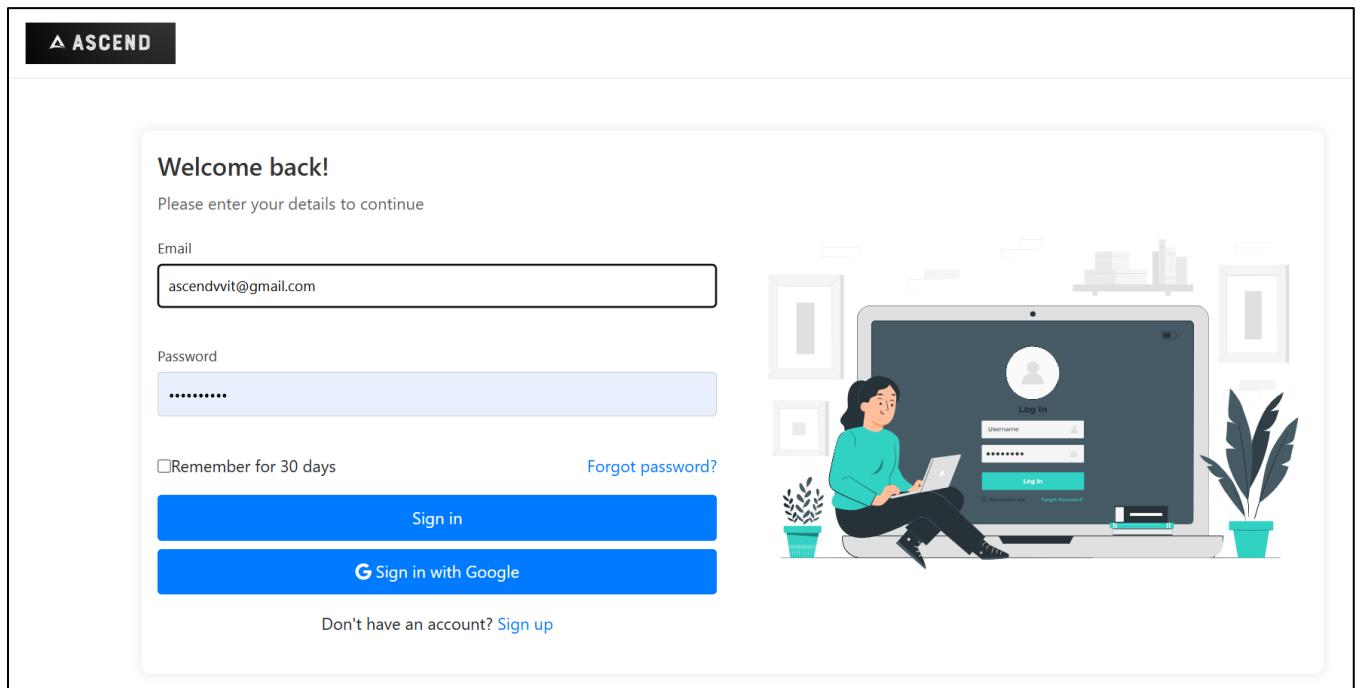


Fig 6.7: User Sign in page with Sign in with Google option for Gmail user's

User Profile and Blogs page:

The User Profile page, accessible via the navigation bar, serves as a central hub for users to manage their personal information and their authored blog content on the ASCEND platform. This page provides a comprehensive view of the user's profile details and offers functionalities to create, modify, and manage their blog posts. The profile section aims to build a personalized experience, while the blog management section enables users to share their insights and experiences with the ASCEND community.

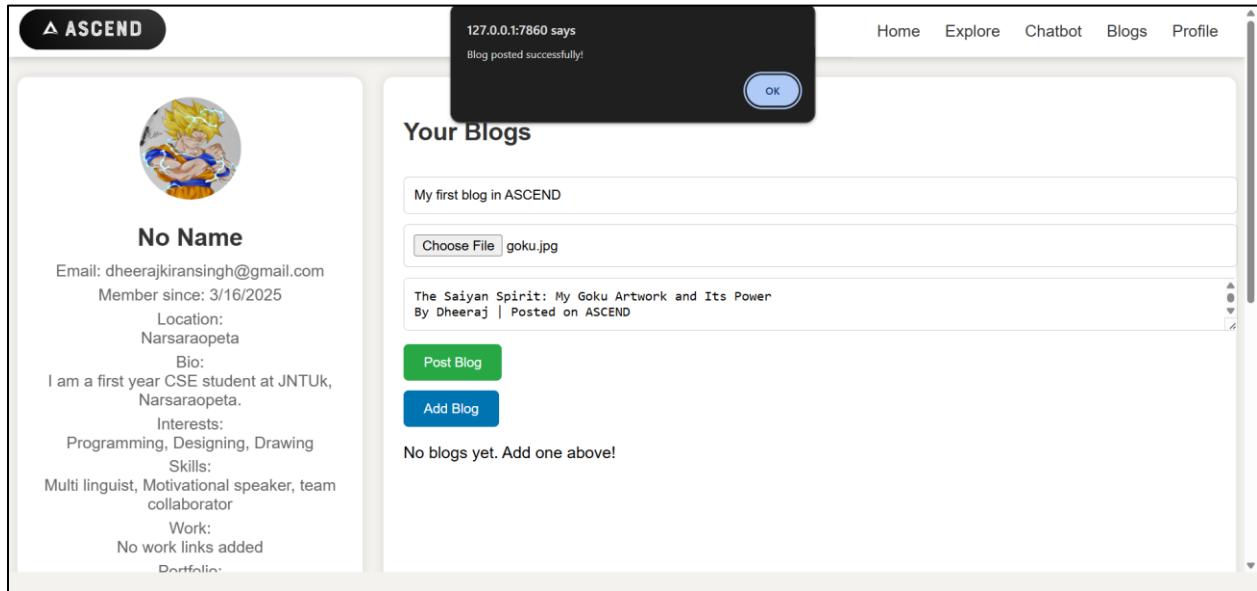


Fig 6.8: User Profile page with user blogs section

Profile Management:

- **Initial State:** Upon initial access to the profile page after signup (especially via the standard signup), fields such as "No Name," Location, Bio, Interests, Skills, Work, and Portfolio are empty. Only the username (derived from the email or chosen during signup) and the "Member since" date are typically populated.
- **Profile Picture:**
 - **Google Login:** If the user registered using "Sign up with Google," the profile picture is automatically fetched from their Google account.
 - **Standard Signup:** If the user registered via the standard signup form, the profile picture area may display a default avatar initially. Users can click an "Edit" option (not visible in this screenshot but implied) to upload a profile picture from their local storage.

- Editing Profile Details:** Users can click an "Edit" button to modify their profile information. This would typically open a form allowing them to update their name, location, bio, interests, skills, and add links to their work or portfolio. Upon saving the changes, the profile section is updated with the new information.
- Logout:** A "Logout" button is present on this page. Clicking it terminates the user's current session, and they will be required to log in again upon their next visit to the website. This is the sole location for the logout functionality within the platform, aiming for persistent user sessions for faster access. Closing the browser window without logging out will maintain the session.

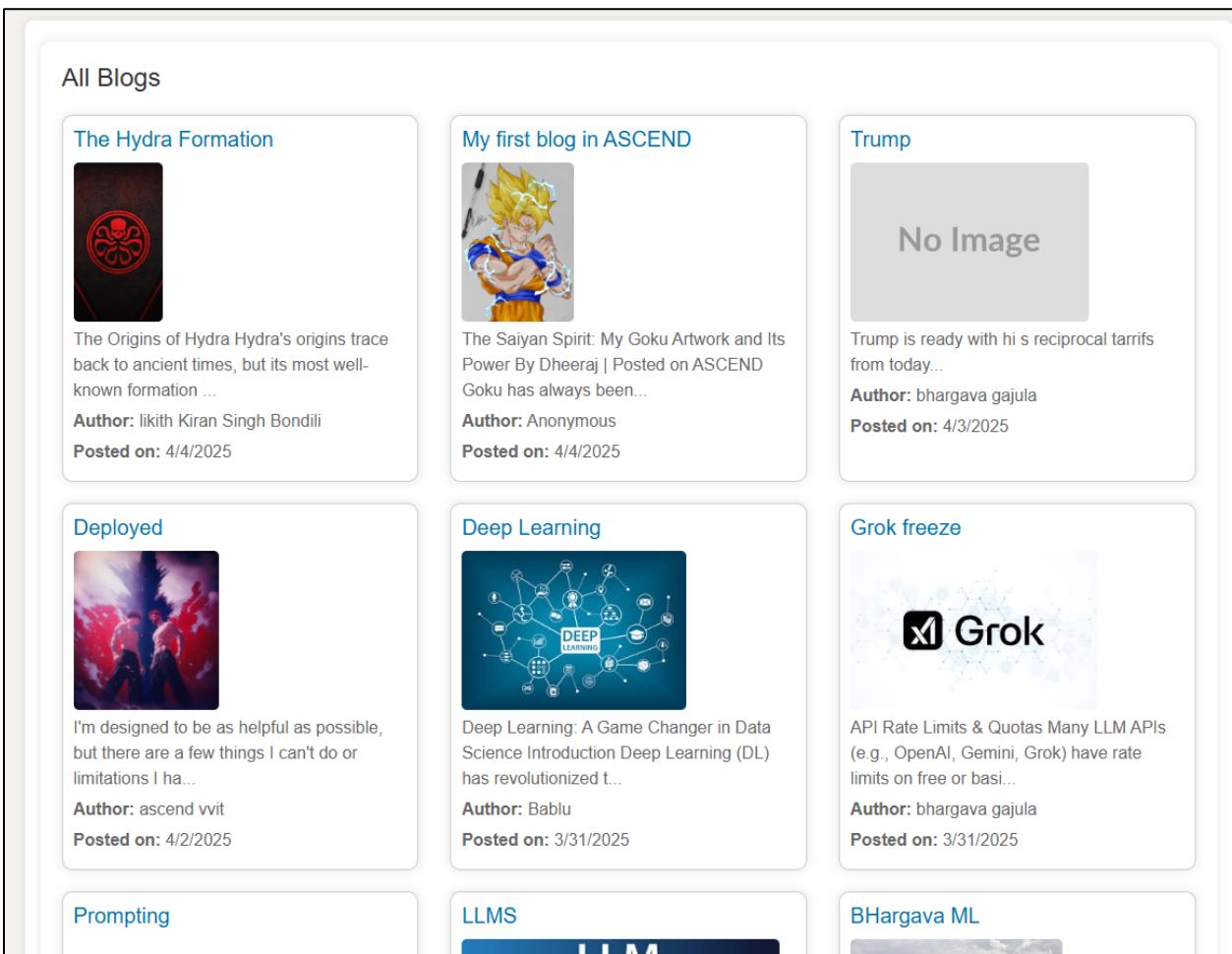


Fig 6.9: Blogs Page displaying all the blogs posted by various user's

Blog Management:

- Displaying Blogs:** The "Your Blogs" section lists all the blog posts created by the currently logged-in user. Each entry typically displays the blog title and potentially a preview or metadata.

- **Adding a Blog:**
 1. The user clicks the "Add Blog" button. This likely navigates the user to a dedicated "Create Blog" page (not shown) or expands a section on the current page with fields for blog creation.
 2. The user provides a title for their blog in the designated text input field.
 3. The user clicks the "Choose File" button to select an image from their local storage to accompany the blog post. The screenshot shows "photo.jpg" has been selected.
 4. The user can optionally add a more detailed description or content for their blog (the specific mechanism for this is not fully visible in the screenshot but is implied).
 5. The user clicks the "Post Blog" button.
- **Blog Posting Process:** Upon clicking "Post Blog":
 1. The blog title, selected image, and description (if provided) are sent to the backend server.
 2. This data is then stored in Google Firebase, associating it with the user's account.
 3. Upon successful storage, a pop-up notification "Blog posted successfully!" (as seen in the screenshot) is displayed to the user, confirming the action.
- **Editing and Deleting Blogs:** Functionalities to edit and delete existing blogs are implied but not directly visible in this specific view. There would likely be "Edit" and "Delete" buttons or options associated with each listed blog.

The User Profile page empowers users to build their online presence within the ASCEND community and share their thoughts and resources through the blog feature, all while maintaining control over their personal information.

Landing Page and Search Functionality:

This page serves as a landing and search platform for a career guidance website, enabling users to explore job opportunities. The search functionality allows users to input a job role and location, such as "Job Role" and "Job Location" to retrieve relevant job listings. Results display job details, including the job title, company, and location, along with a "View Job" link redirecting to the application page, as shown in the output. The page also features AI-powered career guidance, mentorship options, and quick links for skill development and networking, enhancing the user's career journey.

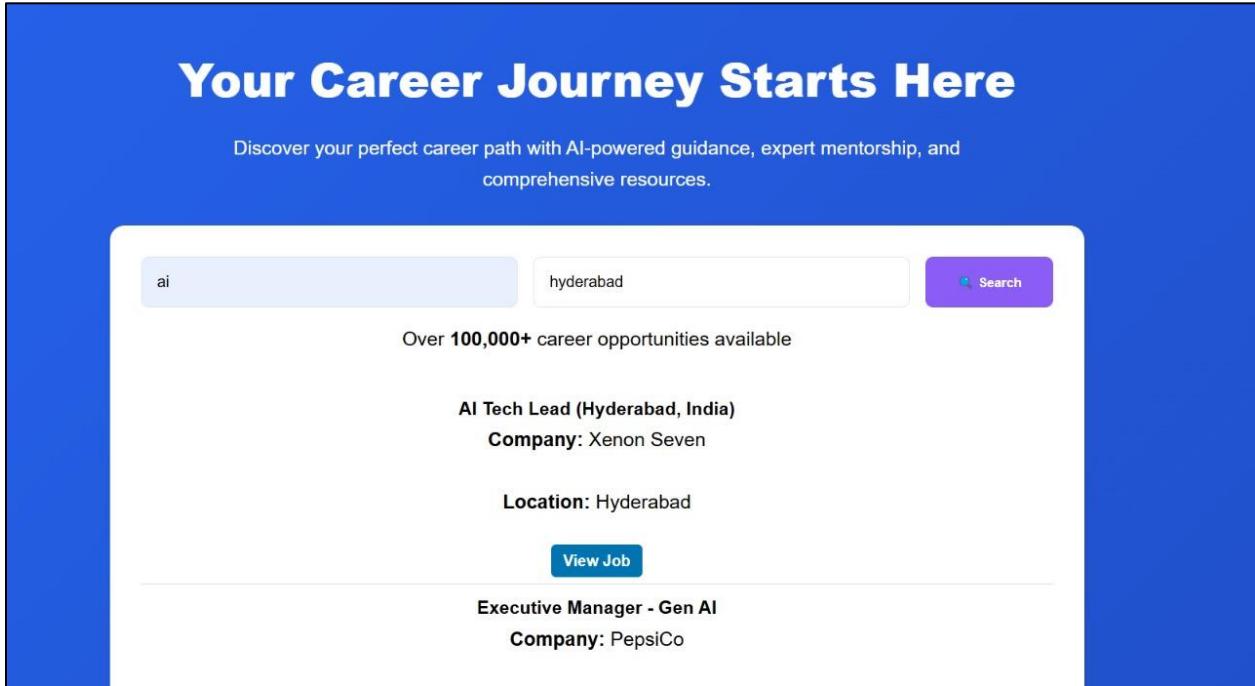


Fig 6.10: Landing Page and Search functionality

Careers Explore and Details Page:

The Career Exploration page serves as an informational gateway for users to discover a wide variety of potential career paths. This page provides a non-interactive overview of different professions, aiming to broaden the user's understanding of the diverse opportunities available. It presents key details for each career, acting as a starting point for further in-depth research and exploration within the ASCEND platform. The information displayed includes the career title, a brief overview of the profession, potential educational and career pathways, and essential skills typically required for success in that field.

The "Explore Careers" button suggests that users can navigate to other sections of the platform for more in-depth information, potentially including detailed descriptions, required qualifications, potential employers, salary expectations, and interactive tools related to each career path. The information on this page serves to pique user interest and guide them towards more focused exploration using other features of the ASCEND platform, aligning with the goal of helping students from middle school to postgraduate levels in exploring and choosing careers that match their interests and strengths.

Browse a variety of career paths to discover potential careers. This page provides a brief overview of different professions. This will be a starting point for understanding different roles and their requirements.

Further Research is recommended for in-depth information.

[Explore Careers](#)

Software Developer

Overview
Create and maintain software applications. Learn programming languages and solve problems.

Pathways
- Bachelor's in Computer Science
- Online Courses & Bootcamps

Skills
Programming (Python, Java), Problem-solving, Teamwork

Graphic Designer

Overview
Create visual content for websites, ads, and more. Use design tools and creativity.

Pathways
- Bachelor's in Graphic Design
- Portfolio & Online Courses

Skills
Design software (Adobe Suite), Creativity, Communication

Data Analyst

Overview
Analyze data to find insights and help businesses make decisions. Learn data tools and stats.

Pathways
- Bachelor's in Statistics/Data Science
- Online Certifications

Skills
Data analysis, SQL, Excel, Problem-solving

Digital Marketing Specialist

Overview
Promote products and services online. Use social media, ads, and content marketing.

Pathways
- Bachelor's in Marketing
- Online Courses & Certifications

Skills
Social media, SEO, Content creation, Analytics

Entrepreneur/Startup Founder

Overview
Start your own business or tech venture. Solve problems, innovate, and build something new.

Pathways
- Self-learning, Networking
- Startup Incubators & Accelerators

Skills

Fig 6.11: Explore Various Career Options Available

Career Overview Cards (five are partially or fully visible): Each card represents a different career option and includes:

- **Career Title:** Examples shown are "Software Developer," "Graphic Designer," "Data Analyst," "Digital Marketing Specialist," and "Entrepreneur/Start-up Founder."
- **Image:** A representative image associated with each career (e.g., a person coding for Software Developer, someone working on a graphic tablet for Graphic Designer).
- **Overview:** A brief description of the typical responsibilities and focus of the career. For example, for "Software Developer," the overview mentions creating and maintaining software applications.
- **Pathways:** Potential educational routes and qualifications that can lead to this career. Examples include "Bachelor's in Computer Science" for Software Developer and "Bachelor's in Graphic Design" for Graphic Designer.
- **Skills:** A list of key skills relevant to the profession. Examples include "Programming (Python, Java)," "Problem-solving," and "Teamwork" for Software Developer, and "Design software (Adobe Suite)," "Creativity," and "Communication" for Graphic Designer.

ASCEND Guide Bot – Sia Bot

The image shows two separate instances of the ASCEND Guide Bot interface, likely demonstrating its conversational capabilities. Both instances have a blue header bar with the text "Welcome to AscendGuide".

Conversation 1:

- User message: "Hello! I'm AscendGuide, your website navigator. How can I help you explore today?"
- Bot response: "Hi, what does this website offers for a class 10th passed out student?"
- Bot message: "Hi there! ASCEND offers several valuable resources for a Class 10th passed-out student. Our "Student Support" page, also known as "Career Compass," is specifically designed to help you navigate your next steps. It provides:
 - **Guidance on Stream Selection:** If you're unsure which academic stream (like Science, Commerce, or Arts) to choose after 10th, Career Compass will help you understand the different options and what each path leads to.
 - **Exploration of Career Opportunities:** We go beyond just academic streams. Career Compass helps you explore a wide range of career possibilities, including entrepreneurship, and provides information on
- Input field: "Type your message..." with a send icon.

Conversation 2:

- User message: "the common paths like BTech or medical school."
- Bot response: "To access this information, simply visit the "Student Support" or "Career Compass" page on our website. You can also use the search bar on our landing page to explore specific careers that interest you. Our Career Mentor Bot is also available to answer any questions you might have."
- Bot message: "can I apply for jobs in your website. I am only 15yrs old"
- Bot message: "While ASCEND provides comprehensive career guidance and resources, you can't directly apply for jobs through our platform at age 15. Many job postings have age restrictions. However, ASCEND is a great tool to start exploring career options, identifying skills you'll need, and preparing for future job applications. I recommend exploring the "Student Support" section (also known as "Your Career Compass") which provides guidance on various career paths available after 10th and 12th grade, including options for skill development while you are still in school. This will help you plan your education and future career effectively."
- Input field: "Type your message..." with a send icon.

Fig 6.12: Working of ASCEND Guide Bot

Ascend Guide serves as a valuable tool for users to quickly get answers to their questions about the ASCEND platform and navigate its various features effectively, contributing to a more user-friendly and accessible career guidance experience.

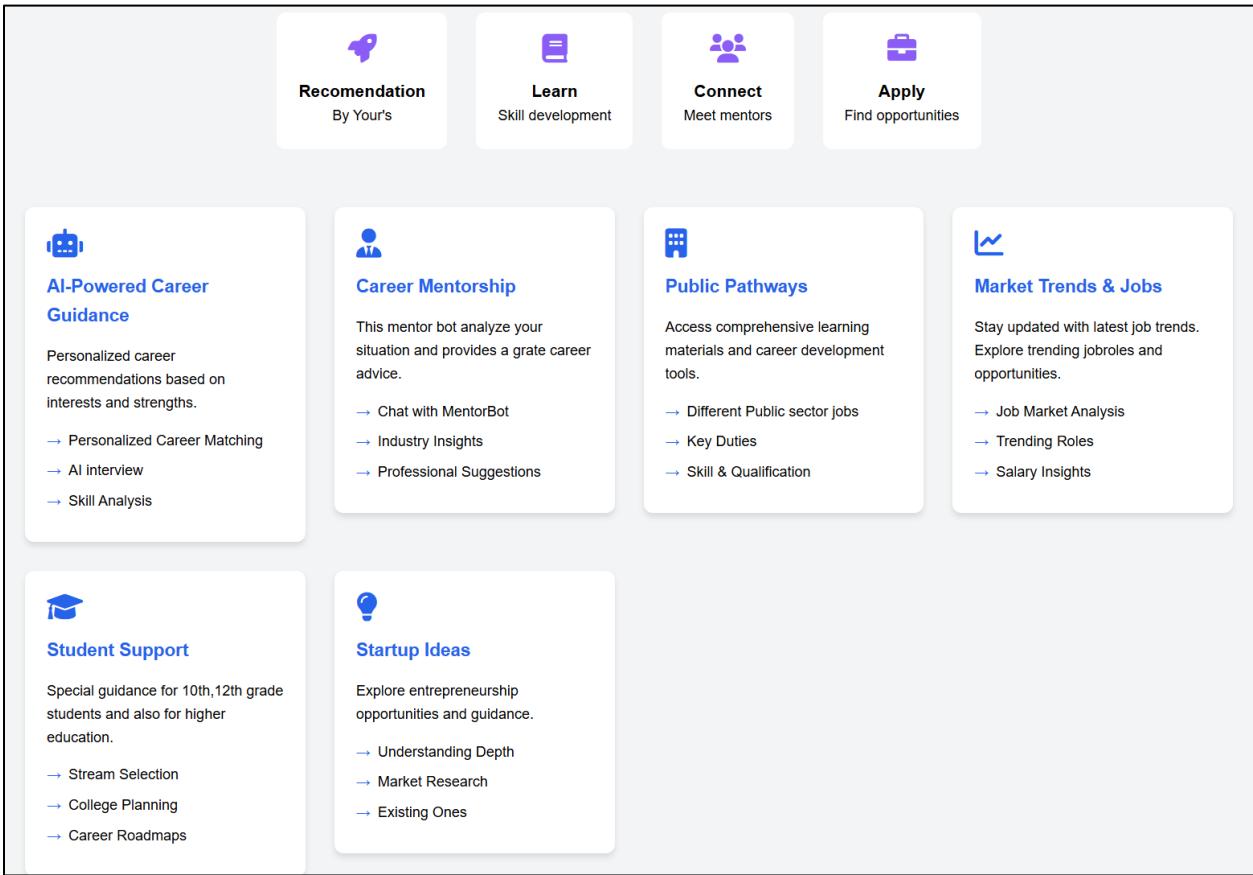


Fig 6.13: Options available for user to interact in the website landing page after sign in

AI-Career Advice:

The ASCEND platform incorporates an AI-powered career advisory tool to provide users with intelligent and personalized guidance. This functionality is implemented through the embedding of an external application. The embedded application, sourced from the Hugging Face platform leverages advanced machine learning models to analyze user input and generate relevant career advice. This advice is produced with the help of various options.

- **Skill Matching and Career Prediction:** The platform uses ML models, specifically a Random Forest-based classifier and Word2Vec embeddings, to analyze a user's skills and predict suitable career paths. This involves comparing the user's skills and qualifications with the requirements of various job roles.
- **Analysis of User Data:** The AI analyzes user data, which may include their skills, interests, educational background, and past experiences, to provide personalized recommendations.

- **Job Market Trend Analysis:** The system uses ML to analyze labour market data, identifying trending job roles and in-demand skills. This helps users stay informed about current opportunities and future career prospects.
- **Personalized Learning Plans:** In addition to career recommendations, the AI can also suggest personalized learning plans to help users develop the skills they need for their chosen career paths.

Customized AI-Powered Career Advice

This app provides AI-powered customized career advice based on your input. Powered by OpenAI GPT 4. Developed by wn. Disclaimer: AI can make mistakes. Use with caution at your own risk!

Desired Career Field Manufacturing	Customized Career Advice Based on your background and aspirations, here's a tailored career pathway to becoming a Product Designer in the manufacturing field: ### Suitable Career Paths: 1. **Product Design Engineer**: Focus on designing and developing products, integrating your mechanical and AI skills. 2. **Industrial Designer**: Combine aesthetics and functionality to create innovative products. 3. **CAD Technician**: Utilize your mechanical engineering knowledge to create detailed drawings and models. 4. **Prototyping Specialist**: Work on developing physical prototypes for products using CAD and crafting skills. ### Additional Qualifications & Courses: 1. **Advanced Product Design Course**: Look for courses that focus on user-centered design, prototyping, and materials science. 2. **CAD Software Certification**: Learn software like SolidWorks, AutoCAD, or CATIA to enhance your design capabilities. 3. **3D Printing and Prototyping Workshops**: Gain hands-on experience with modern manufacturing techniques. 4. **Human Factors and Ergonomics**: Understanding user needs and ergonomics is crucial for successful product design. 5. **Design Thinking Certification**: This approach will enhance your ability to innovate and solve problems creatively. ### Tips on Networking & Gaining Experience: 1. **Join Professional Associations**: Engage with organizations like the Industrial Designers Society of America (IDS) or the Society of Manufacturing Engineers (SME) to network with professionals in the field.
Your Dream Job Product Designer	
Current Qualifications and Certifications Under Graduation in CSE - AI & ML course, Diploma Mechanical Engineering	
Likes Creating new solutions for existing problems, drawing, innovating	
Skills crafting works, mechanical works, product designing, parts fitting	
Clear	Submit

Fig 6.14: Customized AI-Powered Career Advice

Learn Courses Page:

1. **User Input and Personalization:** The embedded application likely provides a user interface where individuals can input information such as the topic they want to learn, their current skill level, and their learning goals.
2. **AI-Powered Roadmap Generation:** Based on the user's input, the AI model hosted on the Hugging Face Space processes this information to generate a personalized learning roadmap. This roadmap typically outlines a structured path of learning, broken down into modules or stages, with estimated durations.
 - **Progressive Stages:** The path is logically sequenced, building upon foundational knowledge in each stage. This allows learners to gradually increase their skills and tackle more complex challenges.
 - **Clear Objectives:** Each stage has well-defined objectives, specifying what learners should achieve (e.g., building core knowledge, applying advanced techniques, developing expert-level skills).

Fig 6.15: Course Recommendation with Roadmap Generation

- **Key Concepts:** The curriculum highlights the essential concepts covered in each stage, providing a roadmap of the theoretical and practical knowledge learners will acquire.
- **Practical Milestones:** Milestones offer tangible goals, allowing learners to track their progress and validate their understanding through practical achievements (e.g., completing projects, solving real-world problems).
- **Hands-on Practice:** The emphasis on practice activities underscores the importance of practical application in learning Python. These activities range from exercises and tutorials to project implementation and community engagement.
- **Recommended Projects:** The inclusion of project suggestions at each level provides learners with concrete ways to apply their skills and build a portfolio. Projects are categorized by difficulty, aligning with the learner's progression.
- **Learning Resources:** The output offers valuable resources, including recommended books, online courses, and communities, to support learners in their journey.
- **Essential Tools:** It lists essential tools for Python development, such as development environments, version control systems, and testing frameworks, preparing learners for professional practices.
- **Career Opportunities:** The overview connects Python proficiency to potential career paths, highlighting the versatility of the skill in software development, data science, and IT operations.

3. **Course Recommendations:** A specific course recommendation with a rating, difficulty level, and skill focus is provided, giving learners a starting point for further education.

Mentor Connect Page:

The Expert Mentors page provides a platform for users to connect with experienced professionals who can offer guidance and support on their career journeys. This page features a curated list of mentors, each with their expertise and contact information readily available. The page also allows users to search for mentors based on their expertise or to contact the admin for further assistance.

Working:

1. **Browsing Mentors:** Users can browse through the list of mentors displayed on the page to find those with expertise relevant to their career interests.
2. **Filtering Mentors:** The "All Expertise" dropdown menu allows users to filter the list of mentors by their expertise areas, making it easier to find the most suitable mentor for their needs.
3. **Searching for Mentors:** The search bar can be used to search for mentors by name or profession related to their expertise.
4. **Contacting Mentors:** Users can click on the "Contact" button on a mentor's card to reach out to them via email or other provided contact information.
5. **Contacting the Admin:** If a user cannot find a suitable mentor or has other questions, they can use the "Contact Us" link in the footer to reach out to the admin team for further assistance.

ASCEND

Search mentors...

Our Expert Mentors

To interact with any mentor, please [contact us](#)

All Expertise ▾

Dr. Sarah Johnson
Career Development Specialist

Ph.D. in Psychology
Certified Career Counselor

Expertise:
Career Transition
Professional Development Leadership

New York, NY
sarah.j@careerguide.com
(555) 123-4567

Michael Chen
Tech Industry Advisor

MS in Computer Science MBA

Expertise:
Software Development Tech Startups
Product Management

San Francisco, CA
michael.c@careerguide.com
(555) 234-5678

Dr. Emily Rodriguez
Academic Counselor

Ed.D. in Education Licensed Counselor

Expertise:
Higher Education Research
Academic Planning

Boston, MA
emily.r@careerguide.com
(555) 345-6789

Fig 6.16: Mentor Information Page for User's

Skill-Based Job Finder:

Through advanced machine learning algorithms (Random Forest and Word2Vec), this feature matches users with private sector jobs based on their skills, industry preferences, role categories, and departments. Users can input preferences manually or upload their resumes for automated matching, streamlining the job search process.

Job Finder

Industry Type: Education

Role Category: Designer

Department: Research

Teaching Curriculum Development Student Counseling Educational Administration

Submit

OR

Upload Resume

Learning Design and Technology Faculty Position (Tenure-line, Open Rank)
Company: George Mason University
Location: Fairfax

[Apply Now](#)

Assistant/Associate Professor of Research Design, Methods, and Analysis
Company: William & Mary
Location: Williamsburg

[Apply Now](#)

Assistant or Associate Professor of Education (Instructional Technology)
Company: University of Virginia

Fig 6.17: User Skill-Based Job Finder

Upload Your Resume

Drag & Drop your resume here or

Browse Files

Upload

No Logo

AI DATA SCIENTIST/MACHINE LEARNING ENGINEER - SOFTWARE ENGINEER II
Company: Sasaki Evolutionary Integration Services (SEIS), LLC
Location: Reston, US

EY

AI & Machine Learning Engineer - Manager - Consulting - Location OPEN
Company: EY
Location: Arlington, US

Machine Learning Engineer

Company: Ecalon, LLC
Location: Location Not Available

Fig 6.18: Resume Analysis Skill-Based Job Finder

Job Role Predictor:

The ASCEND platform incorporates an AI-powered Job Role Predictor, enabling users to discover potential career paths based on their self-described interests and skills. This feature utilizes machine learning models to analyze user-provided text and predict relevant job roles, offering a personalized approach to career exploration. By inputting their areas of interest and existing skills, users can gain insights into potential career matches that align with their individual profiles.

- **"Your Interests" Text Area:** A field where users can input their areas of interest, such as "problem solving," "creative design," or "data analysis."
- **"Your Skills" Text Area:** A field where users can input their existing skills, such as "Python," "JavaScript," or "Project Management."
- **"Predict Role" Button:** A button that, when clicked, triggers the AI model to process the entered interests and skills and generate a list of predicted job roles. A visual spinner indicates processing.
- **"Predicted Job Roles" Section:** A designated area where the AI-generated list of potential job roles is displayed to the user.

Working of the Job Role Predictor

The Job Role Predictor helps users discover potential careers by analyzing the interests and skills they provide. Here's a breakdown:

1. User Input:

- Users type in their interests (e.g., "designing", "analyzing data").
- They also type in their skills (e.g., "coding", "communication").

2. Sending to the AI:

- When the user clicks "Predict Role", this information is sent to the website's backend, where the AI is located.

3. AI Analysis:

- The AI uses Natural Language Processing (NLP) to understand the meaning of the entered interests and skills.
- The AI then compares these to a database that links specific interests and skills to different job roles.
- Machine learning models are used to find the best matches.

4. Prediction Output:

- The AI sends back a list of job roles that are considered a good fit.
- These roles are displayed on the webpage for the user to see.

Job Role Predictor

Your Interests

problem solving, AIML, Business Analyst

Your Skills

python, ml, content writing, prompting

Predict Career Path ➔

Predicted Job Roles:

- Machine Learning Engineer
- Data Scientist
- AI Prompt Engineer
- Business Intelligence Analyst
- Data Analyst
- AI Consultant
- NLP Engineer
- Product Manager (AI-focused)

Job Role Predictor

Your Interests

Game development manager

Your Skills

team coordination, game testing, project managing, game development

Predict Career Path ➔

Predicted Job Roles:

- Game Development Manager
- Project Manager
- Game Producer
- Studio Manager
- Game Director
- Lead Game Designer
- Production Manager
- Senior Game Tester

Fig 6.19: Job Role Predictor

The AI-powered Job Role Predictor offers users a quick and intuitive way to explore potential career paths that align with their individual. By leveraging AI, the platform can provide personalized suggestions, potentially exposing users to career options they may not have considered otherwise. This feature directly supports the platform's goal of assisting users in exploring and choosing careers that match their interests and strengths.

Interview Preparation Chatbot:

The Interview Chatbot uses the Gemini API to conduct simulated interviews by analyzing user resumes and generating relevant questions on skills, projects, and experience. It evaluates responses, provides feedback, and helps users improve their interviewing skills, boosting confidence for real-world interviews.

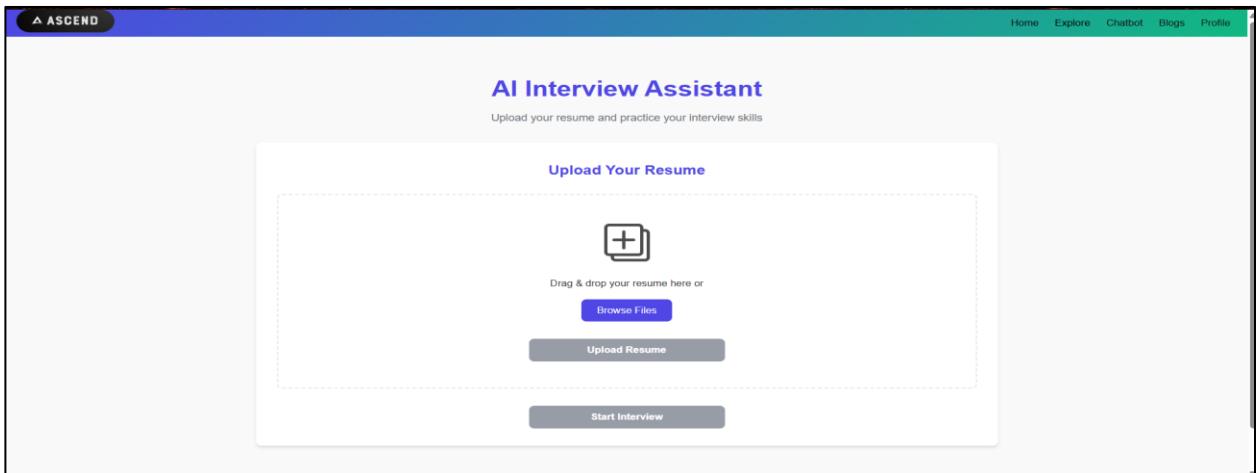


Fig 6.20: Interview Assistant Resume Upload Field

A screenshot of the "AI Interview Assistant" interface. The title "AI Interview Assistant" is at the top, followed by the sub-instruction "Upload your resume and practice your interview skills". Below this is a section titled "Interview Questions" containing a question: "2. The Farm2Fork project highlights real-time inventory management. What technologies or strategies did you use to ensure data accuracy and consistency across the platform, particularly considering the perishable nature of the products?". A user's response is shown in a text box: "yes we ensured it using ~~mongodb~~ with crud operations". At the bottom right is a blue "Submit Answer" button. In the bottom left corner, there is a "Feedback:" section with a note: "***1. Evaluation of Correctness:** The answer is severely lacking. Saying "yes we ensured it using MongoDB with CRUD operations" is insufficient. It doesn't explain *how* CRUD operations in MongoDB ensured data accuracy and consistency, especially considering the perishable nature of the products. The answer

Fig 6.21: Interview Preparation Chatbot Functionality

Career Mentor Bot:

This feature offers real-time mentorship through an AI-powered chatbot (using Python, pickle, and Gemini API). Users can seek guidance on career advice, resume tips, job search help, and interview preparation, with the bot acting as a conversational mentor to navigate the platform and career options.

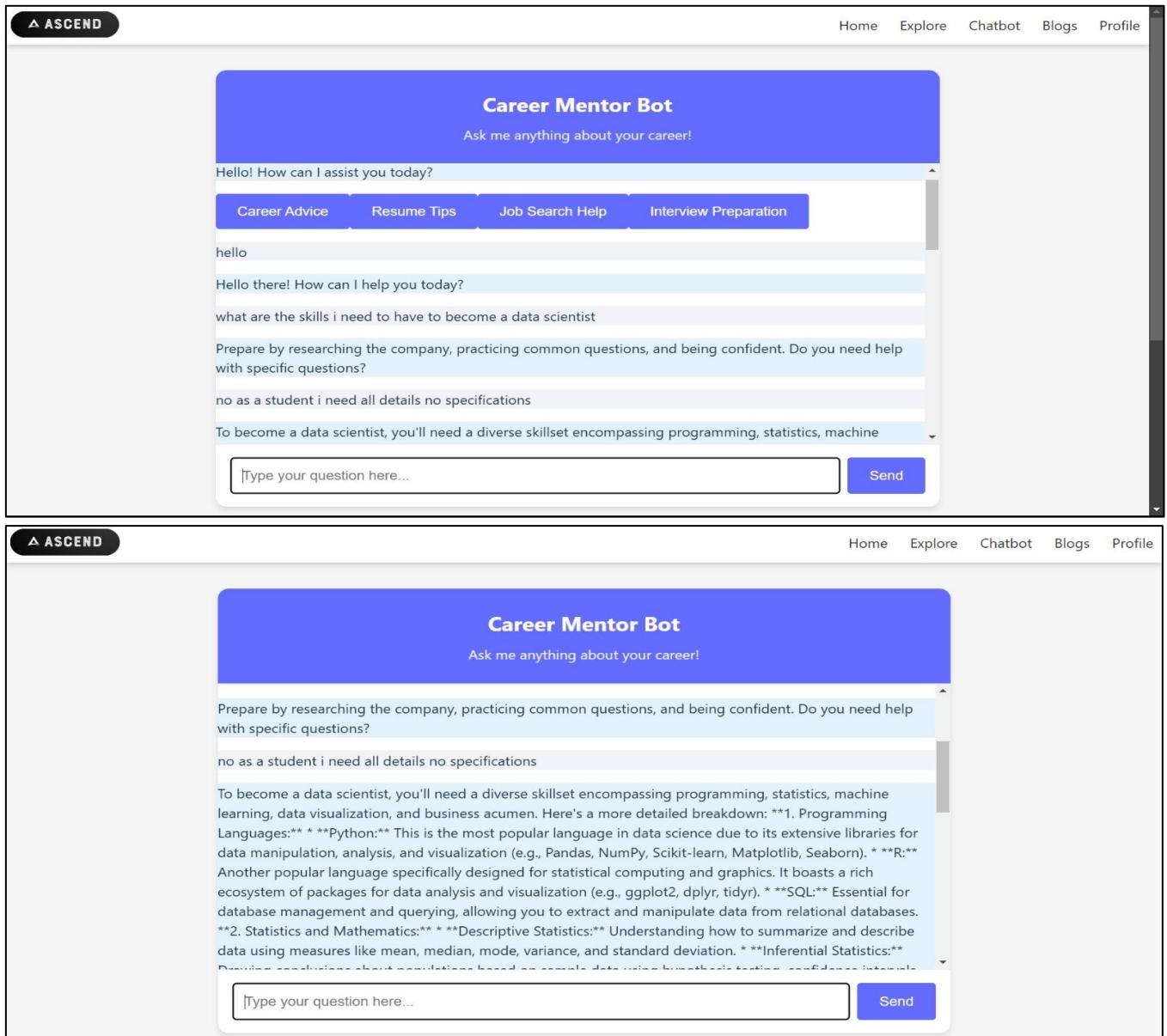


Fig 6.22: Career Mentor Chatbot Functionality

Public Pathways:

The Public Pathways page is dedicated to outlining the diverse career opportunities available within various sectors of the Indian government. Recognizing that many users may lack comprehensive knowledge of the different pathways and roles within the public sector, this page aims to provide detailed information to guide aspiring candidates. It showcases various government sectors and their sub-sectors, offering insights into the responsibilities, key duties, required skills, qualifications, and work environment associated with different government careers. The information presented is derived from official Indian government sources to ensure accuracy and relevance.

The screenshot displays the 'Public Pathways' section of a website. At the top, there's a banner with the text 'Explore Career Opportunities Across Various Government Sectors'. Below the banner, two Indian flags are shown side-by-side. The main content area features six cards, each representing a different government sector:

- Forestry & Wildlife**: Focuses on forest conservation and wildlife protection. It includes an image of deer in a forest.
- Governance & Administration**: Covers public administration and governance systems. It includes an image of the Rashtrapati Bhavan dome.
- Health & Family Welfare**: Focuses on healthcare services and family welfare programs. It includes an image of a family and medical staff.
- Home Affairs & National Security**: Deals with internal security and law enforcement. It includes an image of a meeting room.
- Housing & Urban Development**: Covers housing programs and urban infrastructure development. It includes an image of a city map.
- Info Bro**: Focus and p

At the bottom of the page, there's a dark footer bar with links to 'About', 'Resources', 'Legal', and 'Connect' sections, along with social media icons for Twitter and LinkedIn.

Fig 6.23: Public Pathways Page

Working:

- Information Display:** This page presents a visual overview of various public sector career avenues through informative cards. Users can browse through these cards to identify sectors of interest.
- Sector Exploration:** Clicking on a specific sector card (though the interactivity isn't directly shown in this view) would likely lead the user to a dedicated page or expanded section providing more detailed information about the sub-sectors and specific career roles within that sector.
- Detailed Career Information (Example - Defence Sector/Combat Specialist, based on description):** Upon navigating to a specific sub-sector (e.g., "Combat Specialist" under "Defence"), users would find information such as:

- **Description:** A summary of the role's responsibilities (e.g., conducting combat operations).
- **Key Duties:** A list of specific tasks involved in the role (e.g., engaging in combat, operating weapons systems).
- **Skills Required:** Essential skills needed for the career (e.g., combat skills, physical fitness, teamwork).
- **Qualifications & Requirements:** Educational or training prerequisites (e.g., selection through tests, military training).
- **Additional Information:** Contextual details about the work environment (e.g., Hybrid/On-site).

4. **Educational Awareness:** By providing this structured information, the Public Pathways page aims to educate users about the diverse range of government careers, the specific requirements for each, and the necessary steps to pursue them. This addresses the issue of limited information and helps users make more informed decisions about their career paths in the public sector.

The Public Pathways page serves as a valuable resource within ASCEND, empowering users with the knowledge needed to explore and understand the various opportunities available within the Indian government, thereby aligning with the platform's goal of providing comprehensive career guidance.

Market Trending Job Roles:

The Market Trends page provides users with insights into the currently trending job roles across various industries. This feature aims to keep users informed about the most in-demand career paths, helping them identify potential opportunities and understand the evolving landscape of the job market. Each trending job role is presented with a brief overview and a direct link to explore more detailed information and available job openings from various external sources. This enables users to seamlessly transition from discovering trending roles to exploring real-world application opportunities.

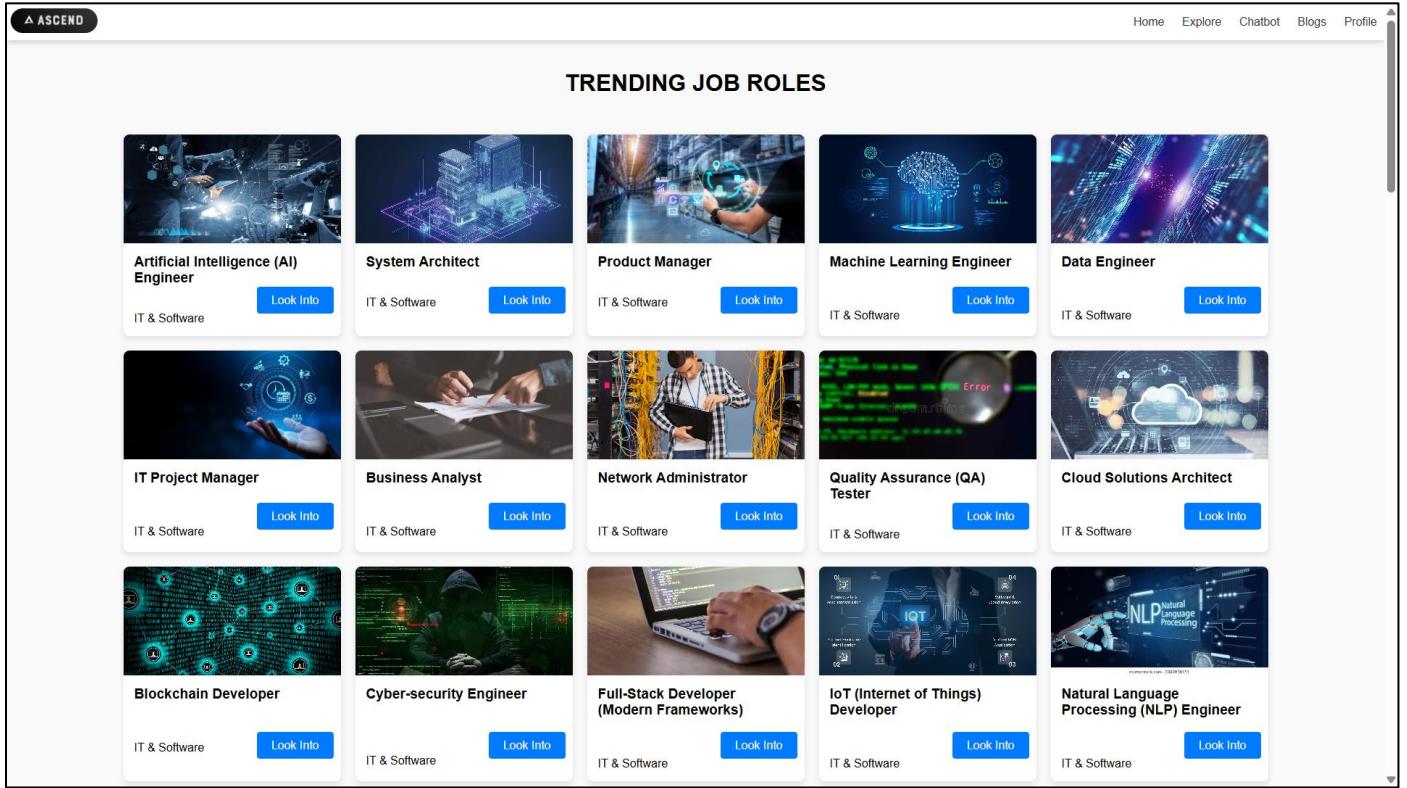


Fig 6.24: Market Trends Job Roles Page

The Market Trends page serves as a dynamic resource within ASCEND, empowering users with up-to-date information on in-demand careers and providing a direct pathway to explore and apply for relevant job opportunities, aligning with the platform's goal of supporting career exploration and navigation.

Career Compass Page:

This page is specifically designed to empower students with comprehensive information about the various educational and career pathways available to them after completing different levels of education. Addressing the issue of students often making choices based on societal or parental pressure rather than informed decisions, this feature provides a clear overview of potential opportunities aligned with different academic streams and interests. Students can explore the possibilities available after key educational milestones (e.g., 10th grade, 12th grade, and after graduation), enabling them to proactively plan their future academic and professional journeys. Each listed course or pathway includes details about the key skills that are beneficial or necessary for success in those fields.

Career Options After 10th Grade

Comprehensive career options after completing 10th grade in India.

Further Education (Science - MPC)
10th Pass

Pursue 11th and 12th in Science stream with Mathematics, Physics, and Chemistry (MPC). Opens doors to engineering, architecture, and related fields.

Mathematics, Physics, Chemistry, Analytical Skills

Further Education (Science - BiPC)
10th Pass

Pursue 11th and 12th in Science stream with Biology, Physics, and Chemistry (BiPC). Leads to medical, paramedical, and related fields.

Biology, Physics, Chemistry, Observation Skills

Further Education (Science - PCMB)
10th Pass

Pursue 11th and 12th in Science stream with Physics, Chemistry, Mathematics, and Biology (PCMB). Offers flexibility for both engineering and medical careers.

Mathematics, Physics, Chemistry, Biology, Analytical Skills

Further Education (Science - MPC with Computer Science)
10th Pass

Pursue 11th and 12th with MPC and Computer Science. Prepares for IT, software development, and AI.

Mathematics, Physics, Chemistry, Programming, Logical Reasoning

Further Education (Science - BiPC with Psychology/Home Science)
10th Pass

Pursue 11th and 12th with BiPC and Psychology/Home Science. Leads to careers in psychology, nursing, and nutrition.

Biology, Physics, Chemistry, Psychology, Nutrition

Further Education (Commerce)
10th Pass

Pursue 11th and 12th in Commerce stream. Opens opportunities in finance, accounting, and business management.

Accounting, Economics, Business Studies, Financial Literacy

Further Education (Commerce - MEC)

Further Education (Commerce - CFC)

Further Education (Commerce - Commerce with Computer)

Fig 6.25: Career Compass page showing various career paths available after 10th grade

Working:

- Level-Based Exploration:** Users can navigate through the different educational levels (After 10th, After 12th, After Degree) using the tabs at the top of the page to see relevant career and educational options for each stage.
- Pathway Discovery:** Within each educational level, various potential pathways are presented as cards. Users can browse these cards to understand the diverse options available.
- Information at a Glance:** Each card provides a concise summary of the pathway, including the subjects involved and the general career directions it can lead to.

The screenshot displays the 'Master's Degrees (Postgraduate Courses)' section of the Career Compass page. At the top left is a 'Back to All Paths' button. Below it, the title 'Master's Degrees (Postgraduate Courses)' is displayed in bold blue text. A sub-instruction 'Pursue a Master's degree in a specialized field for higher studies and research.' follows. Underneath, 'Qualification: Bachelor's Degree' and 'Key Skills' are listed, with three categories: 'Advanced Research', 'Specialized Knowledge', and 'Analytical Skills'. The main content area is titled 'Specializations & Career Paths' and lists eight master's degree options in separate boxes:

- M.Tech / ME**: For B.Tech/B.E. graduates. Specializations: AI, Robotics, Data Science, Civil, Mechanical, etc.
- M.Sc.**: For B.Sc. graduates. Specializations: Physics, Chemistry, Mathematics, Biotechnology, Environmental Science, etc.
- M.Com**: For B.Com graduates. Specializations: Taxation, Financial Accounting, Banking & Insurance.
- MBA (Master of Business Administration)**: Specializations: Digital Marketing, Healthcare Management, Entrepreneurship, International Business, Supply Chain... Management, Business Analytics.
- MA**: For Arts students. Specializations: History, Economics, Journalism, Public Administration, Linguistics.
- LLM (Master of Laws)**: For LLB graduates. Specializations: Corporate Law, Human Rights, Intellectual Property.
- MCA (Master of Computer Applications)**: For BCA/B.Sc. CS graduates.
- M.Des (Master of Design)**: For design graduates. Specializations: Product Design, Fashion Technology.

Fig 6.26: Career Compass page showing Specialization and Career Paths in a course

4. **Skill Awareness:** The "Key Skills/Subjects" section on each card highlights the core areas of knowledge and abilities that are important for success in that pathway, helping students understand the academic focus and potential future skill development required.
5. **Informed Decision Making:** By presenting a range of options beyond traditional choices and providing insights into the associated skills and career directions, this page empowers students to make more informed decisions about their future, aligning their choices with their interests and potential strengths [cite: A-b6-Abstract.docx]. This feature directly addresses the issue of societal and parental pressure by showcasing the breadth of opportunities available after each educational milestone.

Startup Ideas and Guidance:

The Startup Ideas Module provides a curated list of trending startup ideas with industry insights and allows users to submit their own concepts for community feedback. It fosters innovation by offering resources on market potential, target audiences, and competitive landscapes for aspiring entrepreneurs. Users can also access startup news in the same features where the details on new startups are updated daily so that user can get daily updates in the start-ups innovative world. The stradeas allows user to search for a start up in a particular field and find the relevant information. This helps the user to know about the journey of many start up ideas.

The screenshot displays the STRADEAS platform interface. At the top, there is a search bar with the query "automobile" and a result count of "Results Count : 500". Below the search bar, there are four main sections: 1) "List of unicorn startup companies" which defines a unicorn as a privately held startup company with a current valuation of US\$1 billion or more; 2) "Automotive industry in India" which notes it is the world's fourth-largest by production and valuation; 3) "Seres Automobile" which is described as a Chinese company formerly known as Chongqing Jinkang New Energy Automobile Co., Ltd.; and 4) "DeLorean Motor Company" which was an American automobile manufacturer formed by John DeLorean in 1975. Each section includes a "Read More" button. To the right, there is a sidebar titled "jidi Auto" which is a joint venture between Baidu and Geely, headquartered in Shanghai, with a "Read More" button. Below it is another section titled "Arrivo" which was a startup company in Los Angeles developing a maglev rail, also with a "Read More" button. The bottom section is titled "Zoox (company)" which names Intel Executive Aicha Evans as CEO, with a "Read More" button.

Fig 6.27: Startup Ideas and Guidance using links to respective web pages

Chapter 7

Conclusion and Future Work

7.1 Proposed System Functional Solutions

The AI-driven career exploration platform effectively utilizes machine learning and natural language processing techniques to offer personalized career guidance. It provides users with detailed career information, insights into market trends, and tools for skill development. The platform enhances the career exploration process by offering interactive tools, personalized recommendations, and real-time mentorship support.

7.2 Key Achievements and Contributions

- The project developed an innovative platform that integrates machine learning (ML) and natural language processing (NLP) to revolutionize career guidance.
- The platform employs a Random Forest-based classifier and Word2Vec embeddings for accurate skill matching and career prediction.
- It offers a diverse resource portal with detailed career information, including job roles, market trends, startup insights, and skill development plans.
- The platform incorporates interactive tools such as career compasses, search and filter options, and a personalized guide bot ("Sia") to enhance user engagement.
- It provides real-time mentorship through chat features, personalized career recommendations, skill assessments, and access to blogs and public pathways.
- The project contributes to bridging the gap between traditional career guidance and modern labor market demands.

7.3 Challenges Faced

The reference text mentions the following challenges in the context of career guidance systems:

- **Limitations of existing models:** Some existing models are limited to a restricted number of industries, which may not fully address the diverse career needs of users across various sectors.

- **Lack of interactivity and adaptability:** Some systems lack features for real-time mentorship and adaptability to career shifts, which are critical for addressing the needs of freshers and professionals undergoing career transitions.
- **Ensuring real-time data and scalability:** Challenges include scaling the system to cover a broader range of industries and providing real-time job market data.

The text also details how the proposed platform addresses these challenges by providing a comprehensive and user-centric approach to career guidance, incorporating features like:

- A diverse resource portal.
- Interactive tools.
- Personalized recommendations.
- Real-time mentorship.
- Use of machine learning and NLP techniques to provide accurate and adaptable career guidance.

7.4 Future Scope and Improvements

The reference text suggests the following directions for future work and improvements:

- **Expanding industry coverage:** Future work could focus on scaling the system to cover a broader range of industries to provide more inclusive career guidance.
- **Enhancing interactivity and personalization:** Further improvements could focus on enhancing interactivity and personalization in career guidance systems to better address the needs of users.
- **Integrating real-time data:** Future development could prioritize the integration of real-time job market data to provide users with the most current information.
- **Real-time job exploration with generative AI and APIs:** Future research could explore the use of generative AI and APIs for real-time job exploration.

CHAPTER 8

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Books:

- "**Career Theory and Practice: Learning Through Case Studies**" by **Duane Brown and Linda Brooks**. This book provides a comprehensive overview of career development theories and practical applications.
- "**Designing Your Life: How to Build a Well-Lived, Joyful Life**" by **Bill Burnett and Dave Evans**. While focusing on design thinking, it offers valuable insights into career exploration and decision-making.
- "**Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow**" by **Aurélien Géron**. A practical guide to machine learning concepts and implementation.
- "**Natural Language Processing with Python**" by **Steven Bird, Ewan Klein, and Edward Loper**. A comprehensive introduction to NLP using the NLTK library.

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