ÇANKAYA UNIVERSITY FACULTY OF ENGINEERING
COMPUTER ENGINEERING DEPARTMENT

Project Report
Version 1

CENG 407
Innovative System Design and Development I

P202407

Job Application and Matching Platform
Cem Sarıdoğan
202011065
Emir Cüneyt Şanlı
202011043
İrem Güngör
202111040
Tuğba Yükselen
202111062
Ali Özen
201911409

Advisor: Phd. *Faris Serdar Taşe*l

Table of Contents

Abstract

The AI-Powered Job Matching Platform aims to revolutionize the recruitment process by addressing inefficiencies and biases in traditional hiring systems. Current job platforms often rely heavily on technical qualifications and academic credentials, leading to the exclusion of highly capable candidates who may not have graduated from prestigious universities or achieved high GPAs. Our platform provides a fair and efficient two-way matching system that evaluates candidates holistically by considering both hard and soft skills, as well as their professional experience.

This project leverages advanced AI algorithms to offer personalized job recommendations for job seekers while simultaneously enabling employers to discover candidates who best fit their job postings. The backend is developed using Java Spring Boot, ensuring scalability and robustness, while the frontend is implemented using React.js, known for creating dynamic and responsive user interfaces. The AI module, which forms the core of the recommendation system, is built with Python and utilizes popular machine learning frameworks such as PyTorch, TensorFlow, Keras, and Scikit-learn. Data storage is handled using PostgreSQL, and ElasticSearch is integrated for fast and efficient search capabilities.

The development process began with an extensive analysis of existing job platforms and a thorough literature review of AI-driven recommendation systems. Based on our findings, we identified critical gaps in current solutions and designed a modular, scalable architecture to address these issues. By focusing initially on the computer engineering sector, we aim to create a standardized job search process that can be expanded to other industries in the future.

Our platform not only ensures that every candidate is given a fair opportunity but also streamlines the hiring process for employers by reducing the time and effort required to find suitable candidates. Future improvements include expanding into additional sectors, refining the AI models for even greater accuracy, and incorporating real-time feedback from users to enhance the overall user experience. The AI-Powered Job Matching Platform is poised to become a game-changer in the recruitment industry, fostering a more inclusive and efficient job market.

Key words: AI-powered job matching, recruitment platform, machine learning, personalized job recommendations, scalable architecture, fair hiring process, job search standardization.

1. Introduction

The job market is constantly evolving, with both job seekers and employers facing numerous challenges in finding the right fit. Traditional recruitment processes often rely on manual methods and subjective criteria, which can lead to inefficiencies, biases, and missed opportunities. Many job platforms primarily evaluate candidates based on technical qualifications and academic achievements, overlooking critical factors such as soft skills, cultural fit, and real-world experience.

The AI-Powered Job Matching Platform aims to address these issues by offering a comprehensive and unbiased solution that leverages artificial intelligence to enhance the recruitment process. The platform introduces a two-way matching system that not only allows job seekers to find suitable job opportunities but also enables employers to identify the most relevant candidates for their job postings. By integrating machine learning models and advanced data analysis techniques, the platform ensures that both parties benefit from accurate and meaningful recommendations.

This platform is initially targeted at the computer engineering sector, where the demand for highly skilled professionals is high, and the recruitment process can be particularly complex. However, the long-term goal is to expand the platform's scope to other industries, creating a standardized and scalable job matching solution.

The key objectives of the platform include:

1. Fair and unbiased evaluation: Ensuring that candidates are assessed based on a holistic set of criteria, including technical skills, soft skills, and relevant experience.
2. Efficiency in job matching: Reducing the time and effort required for both job seekers and employers by providing accurate, AI-driven recommendations.
3. Scalability: Designing a modular architecture that can easily be adapted and expanded to support additional sectors and functionalities.
4. User-friendly experience: Offering an intuitive interface for both job seekers and employers, with features such as real-time messaging, interview scheduling, and personalized dashboards.

By addressing these objectives, the AI-Powered Job Matching Platform seeks to become a trusted tool in the recruitment industry, fostering a more efficient, inclusive, and effective job market for all stakeholders.

1.1 Company Background

The development team for the AI-Powered Job Matching Platform consists of senior computer engineering students with diverse expertise in software development, machine learning, and system design. Each team member brings prior experience in building software systems using modern technologies such as Java Spring Boot, React.js, and Python-based AI frameworks. This collective experience has enabled the team to adopt best practices in software development, ensuring a robust and scalable product.

Throughout their academic journey, the team has worked on various individual and group projects, which provided valuable hands-on experience in different stages of software development, including requirement analysis, design, implementation, and testing. The decision to focus initially on the computer engineering sector was driven by the team's familiarity with the domain and their understanding of its specific recruitment challenges.

The team's motivation to undertake this project stems from a shared desire to solve real-world problems in recruitment by applying their technical skills and knowledge. With a clear understanding of the industry's pain points and leveraging their collective expertise, the team is committed to developing a platform that can have a tangible positive impact on both job seekers and employers.

By combining their technical expertise with a deep commitment to creating a fair and efficient hiring process, the development team aims to deliver a solution that not only meets but exceeds the expectations of all stakeholders involved.

1.2 Motivation

The idea for this project emerged from the well-documented inefficiencies and biases in the recruitment process. Research indicates that recruiters typically spend less than 10 seconds reviewing a CV, which often results in the elimination of highly capable candidates due to superficial factors such as the prestige of their university or their GPA. This practice frequently overlooks talented individuals who may not have the highest academic credentials but possess valuable skills and experience.

Our platform aims to create a fairer job market by ensuring that candidates are evaluated based on a comprehensive set of criteria, including their technical skills, professional experience, and soft skills. We believe that every candidate deserves an opportunity to find a job that matches their true potential, regardless of their academic background or the institution they attended.

Another critical motivation behind this project is the need to standardize the job search process. The current methods of job seeking and hiring vary significantly across industries, leading to inconsistent experiences for job seekers and employers. By introducing a standardized, AI-driven approach, we aim to streamline the recruitment process and reduce the time and effort required on both sides.

Initially, we are focusing on the computer engineering sector, a field with high demand for skilled professionals and complex hiring requirements. However, our long-term goal is to expand the platform's capabilities to serve other industries, ensuring that the benefits of fair and efficient job matching are accessible to a broader audience.

In summary, the AI-Powered Job Matching Platform is driven by the desire to:

1. Eliminate bias in recruitment: Ensuring that all candidates, regardless of their academic or professional background, have an equal opportunity to be considered for job roles.
2. Enhance efficiency: Reducing the time and resources required for job seekers to find relevant opportunities and for employers to identify suitable candidates.
3. Establish a standard for job matching: Creating a consistent and reliable process for job seeking and recruitment across various industries.
4. Support long-term career development: Helping candidates find positions that align with their skills and career aspirations, contributing to higher job satisfaction and retention rates.

By addressing these challenges, we aim to revolutionize the recruitment industry and create a more equitable job market for all participants.

1.3   Problem Statement

The traditional job recruitment process presents significant challenges for both job seekers and employers. One of the primary issues is the reliance on subjective and superficial criteria, such as university reputation or GPA, which often results in the exclusion of highly skilled candidates who may not meet these arbitrary benchmarks. This creates an unfair environment where many capable individuals are overlooked, leading to inefficiencies in the hiring process.

On the employer side, finding the right candidate involves sifting through large volumes of applications, often with limited time and resources. Without a robust matching system, recruiters may struggle to identify candidates who possess the right combination of technical and soft skills. This not only increases the time and cost of hiring but also reduces the likelihood of finding the best fit for a given role.
Additionally, the lack of a standardized approach to job matching across industries leads to inconsistent experiences for both job seekers and employers. Each platform operates with its own set of criteria and methodologies, making it difficult to establish a reliable and repeatable process for job matching.

By addressing these issues, the AI-Powered Job Matching Platform aims to create a fair, efficient, and standardized recruitment process. The platform leverages advanced AI algorithms to ensure that candidates are matched with job opportunities based on a comprehensive evaluation of their skills and experience, rather than superficial metrics. Through this approach, we seek to improve the overall efficiency of the hiring process, reduce bias, and foster a more inclusive job market.

1.4   Related Work

The problem of matching job seekers with relevant job opportunities has been explored in various academic and industrial studies. Several AI-powered job recommendation systems exist, each employing different techniques to improve the accuracy of matches. For example, platforms such as LinkedIn and Indeed use basic collaborative filtering and keyword-based search algorithms to suggest jobs to users based on their profiles and previous searches.

Despite their popularity, these platforms often suffer from low precision in job recommendations due to their reliance on keyword matching and lack of deeper context analysis. Recent studies have shown that incorporating machine learning models, such as neural networks and graph-based algorithms, can significantly improve the quality of job recommendations by considering both the explicit and implicit preferences of users.

A notable work in this area is the use of transformer-based models like BERT for natural language processing (NLP) tasks related to job descriptions and candidate resumes. These models have demonstrated superior performance in understanding the context and semantics of job-related text, enabling more accurate matches. Additionally, hybrid recommendation systems that combine content-based and collaborative filtering approaches have been proposed to address the cold-start problem, where insufficient data about new users or jobs limits the effectiveness of traditional recommendation methods.

While existing solutions provide valuable insights, they often fall short in evaluating soft skills and cultural fit, which are crucial factors in successful hiring. Our platform builds upon these studies by integrating a holistic evaluation mechanism that includes both technical qualifications and

interpersonal attributes. Furthermore, we address the issue of scalability by designing a modular architecture that can be easily expanded to support different industries.

By leveraging state-of-the-art machine learning techniques and adopting a user-centric approach, the AI-Powered Job Matching Platform aims to set a new standard in recruitment technology, offering a more accurate, fair, and efficient solution for job seekers and employers a like.

1.5   Solution Statement

The proposed solution is an AI-driven job matching platform that offers a two-way matching system, enabling both job seekers and employers to find suitable matches efficiently and fairly. Unlike conventional job platforms, which often rely on keyword-based searches or superficial filters, this platform uses advanced machine learning algorithms to provide personalized job recommendations and candidate suggestions.

Key features of the proposed solution include:

1. **AI-Driven Recommendations:** The platform utilizes advanced machine learning models to analyze candidate profiles and job descriptions, ensuring a high level of relevance in job recommendations. These models consider both technical and soft skills, offering a holistic evaluation of candidates.

2. **Two-Way Matching System:** Job seekers receive personalized job recommendations based on their complete profile, while employers are provided with a list of suitable candidates who match the requirements of their job postings.

3. **Real-Time Interaction Tools:** To enhance communication between candidates and employers, the platform includes features such as real-time messaging, interview scheduling, and notifications.

4. **Scalable and Modular Architecture:** The platform is designed with scalability in mind, allowing it to support an increasing number of users and industries. The modular architecture also enables future enhancements, such as adding new features or integrating external services.

5. **User-Friendly Interface:** Both job seekers and employers can access the platform through an intuitive interface, which includes a personalized dashboard, search filters, and data visualization tools to improve the overall user experience.

6. **Data Privacy and Security:** The platform ensures compliance with data privacy regulations such as **GDPR** and **KVKK**, employing robust security measures to protect user data.

By addressing the key challenges in the recruitment process, the AI-Powered Job Matching Platform aims to create a fairer, more efficient, and standardized job market. The initial focus on the computer engineering sector allows the team to fine-tune the system before expanding to other industries, ensuring a high-quality product that meets the needs of both job seekers and employers.

2. Literature Review

Abstract

This literature review examines the development of an AI-powered job matching platform designed to provide a more balanced and comprehensive job matching process, integrating both technical skills and soft skills. Most existing platforms focus predominantly on candidates' academic achievements and technical competencies, neglecting critical qualities like leadership, work experience, and interpersonal skills. The goal of this project is to enhance job matching by integrating a comprehensive profile analysis that considers both hard and soft skills. This review investigates the use of machine learning-based recommender systems, AI-powered search engines, and user interaction features in job matching processes, identifies gaps in current solutions, and outlines key research directions.

Introduction

Digital job matching platforms such as LinkedIn, Indeed, and Kariyer.net prioritize technical qualifications and academic achievements when evaluating candidates. However, employers increasingly seek candidates who possess soft skills, leadership abilities, and relevant work experience. Current platforms often fail to assess these multifaceted traits adequately, resulting in mismatches between job opportunities and qualified candidates. This literature review addresses the theoretical foundations of an AI-driven job matching platform that considers not only academic and technical qualifications but also professional experience, social skills, and communication competencies. Such a platform will enable employers to find suitable candidates with greater ease while also offering job seekers more relevant opportunities. The review covers the integration of AI-powered recommendation systems, semantic search engines, and real-time support features, outlining the algorithms and AI applications that underpin this project.

Addressing Key Challenges in AI-Driven Job Matching

The development of AI-powered job matching platforms involves several challenges that need to be addressed to ensure an efficient and secure user experience. These include data privacy concerns, algorithmic transparency, communication barriers, and system security.

Ensuring Trustworthiness of AI Algorithms

AI algorithms play a crucial role in the job matching process, particularly in evaluating both technical skills and subjective qualities like interpersonal skills, work experience, and personality traits. Trust in these algorithms is essential, as biased or opaque decision-making can lead to unfair outcomes. The transparency and explainability of AI decision-making processes are critical for ensuring that candidates and employers understand the rationale behind job matches, and for avoiding algorithmic bias. This is especially important when dealing with sensitive candidate data, as users must trust that their information is being assessed fairly and accurately.

ElasticSearch for Enhanced Job Matching

ElasticSearch is an advanced tool for indexing and searching job postings and candidate profiles, making it a key technology in AI-driven job matching platforms. However, challenges arise when integrating ElasticSearch with deeper AI-based analysis of candidate profiles and job descriptions. Traditional keyword-based search methods often do not capture the full semantic context of job postings or candidate qualifications, which can lead to suboptimal matches. To enhance the precision of job matching, it's necessary to balance keyword search with more advanced semantic techniques, such as natural language processing (NLP) and machine learning, which can understand the meaning behind job titles and candidate skills.

Communication Barriers Between Candidates and Employers

One of the most common challenges in job matching platforms is the lack of effective communication tools between candidates and employers. Delays or misunderstandings can arise due to the absence of real-time communication channels. Integrating chat systems, appointment scheduling, and interview coordination tools into the platform is crucial for improving the user experience. However, these features must be scalable and robust, particularly during periods of high traffic, to ensure seamless interaction and avoid system slowdowns.

AI-Driven Search Engines

AI-powered search engines go beyond simple keyword matching by incorporating context-aware search capabilities. These engines leverage advanced techniques such as natural language processing (NLP) and machine learning to interpret user queries semantically, thus improving the relevance and precision of job matches.

Information Retrieval Techniques

Information retrieval methods like ElasticSearch are optimized for large-scale data environments, enabling more effective and context-aware search results. These systems understand the context behind user queries, allowing for more meaningful search results. For example, a search query for "managerial positions" can return results related to roles requiring leadership skills, even if the job titles do not explicitly include the term "manager." This approach improves the precision of search results and provides a more relevant list of job opportunities to the user.

Profile Analysis and Matching

Traditional job matching platforms primarily focus on technical qualifications and academic credentials. However, the goal of this project is to create a more comprehensive analysis of candidate profiles by incorporating both technical expertise and soft skills, such as leadership abilities and interpersonal strengths. By considering these additional factors, AI-driven job matching systems can better align candidates with roles that not only match their technical skills but also their broader capabilities and personality traits, improving overall job satisfaction and retention.

Integrating AI with User Interaction Features

Effective communication is a key component of the job matching process. Real-time interaction tools, such as chat systems and scheduling features, are essential for facilitating faster communication between candidates and employers, which can significantly streamline the hiring process. These features not only improve the user experience but also reduce the chances of misunderstandings and delays during the hiring process.

Online Communication Systems

Many job platforms currently lack integrated communication systems that allow for real-time exchanges between candidates and employers. This project aims to overcome this limitation by implementing chat and scheduling features that will allow for seamless interactions. However, challenges remain in ensuring these features scale effectively during periods of high user activity, maintaining user engagement, and managing expectations to ensure the system remains responsive and reliable.

Related Work

The integration of AI-powered strategies into job recommendation systems has been widely explored in the literature, with several studies focusing on enhancing recommendation accuracy through machine learning, natural language processing (NLP), and graph theory. For instance, AI techniques have been used to personalize job recommendations by analyzing various data sources, such as resumes, user behavior, and even social media interactions (Marr, 2024) [1]. This holistic approach, which includes both technical skills and personality traits, could be beneficial for enhancing the relevance of job suggestions in the proposed platform.

Collaborative filtering (CF) and content-based filtering (CBF) are two popular methods employed for job recommendations. CF relies on user behavior and interactions to predict job preferences, while CBF matches job descriptions with candidate profiles based on attributes like skills and experience. These techniques, which have been widely adopted in job recommendation systems (Behrain, 2024) [2], are often used in hybrid models to combine the strengths of both approaches, thereby addressing issues such as the cold-start problem. The proposed platform could benefit from integrating such hybrid models to deliver more personalized and accurate job recommendations.

Graph-based job recommendation systems, which model relationships between entities (such as jobs, candidates, and companies) as a graph, have also been explored in the literature. These systems use graph theory to uncover deep patterns within the data, considering not just technical skills but also professional networks and career trajectories (Behrain, 2024) [2]. By incorporating graph-based approaches, the proposed platform could gain a deeper understanding of job suitability by factoring in social relationships and career progression.

Transformer-based models, particularly OpenAI's GPT-4, have been explored for improving the semantic understanding of job descriptions and candidate profiles. These models can match candidates with jobs based on the contextual meaning of the descriptions, rather than relying solely on keyword matching (Manzen, 2024) [4]. The application of transformer models like GPT-4 or BERT (Panchasara and Gupta, 2024) [5] could significantly enhance the semantic precision of job recommendations by capturing the full context of job descriptions and candidates' qualifications. In a similar vein, machine learning techniques such as classification and clustering have been applied for real-time personalized job recommendations (Jain and Kakkar, 2019) [6]. These methods can adapt to evolving user preferences and behaviors, thus offering dynamic, personalized recommendations.

Additionally, hybrid approaches have been proven effective in overcoming limitations such as the cold-start problem, particularly in the context of internship matching (Poncio, 2023) [7]. By leveraging both traditional and machine learning-based techniques, hybrid models enable job recommender systems to provide more accurate matches, even with limited data. The proposed platform could draw from these insights to deliver robust job recommendations under varying data availability conditions.

Techniques and Libraries Employed

The development of the proposed AI-powered job recommendation platform integrates a range of advanced techniques and libraries from machine learning, natural language processing (NLP), and graph theory. These methods are chosen to optimize the accuracy, efficiency, and personalization of job recommendations, aiming to address common challenges in traditional job matching systems, as outlined in the related work section.

Collaborative Filtering (CF)

Collaborative Filtering (CF) is a widely adopted approach in job recommendation systems due to its ability to leverage user behavior and preferences. This technique predicts job recommendations based on similarities between users, derived from their past interactions and preferences. There are two primary types of CF: memory-based CF, which computes similarity between users or items based on their interactions, and model-based CF, which uses machine learning algorithms, such as matrix factorization, to predict job ratings and make recommendations. The Surprise library is a popular Python tool for implementing collaborative filtering, offering algorithms like k-Nearest Neighbors (k-NN) and Singular Value Decomposition (SVD), making it suitable for building both memory-based and model-based CF systems.

Content-Based Filtering (CBF)

Content-Based Filtering (CBF) is another technique used to recommend jobs based on the attributes of job listings and candidates' profiles. This method focuses on matching job descriptions with candidate profiles by analyzing features such as skills, job titles, and experience. Feature extraction methods like Term Frequency-Inverse Document Frequency (TF-IDF) are employed to represent job descriptions and profiles as feature vectors. To measure the similarity between candidate profiles and job descriptions, cosine similarity is commonly used. The scikit-learn library is frequently utilized for both feature extraction and similarity calculations, making it a versatile tool for implementing content-based filtering in job recommendation systems.

Hybrid Recommendation Models

Hybrid recommendation models combine the strengths of both Collaborative Filtering (CF) and Content-Based Filtering (CBF) to create a more robust and personalized recommendation system. These models aim to address the limitations of individual methods, such as CF's cold-start problem and CBF's limited scope. By integrating user behavior with job attributes, hybrid models can generate more accurate recommendations. Deep learning frameworks like TensorFlow and PyTorch are employed to develop these hybrid models. These libraries support complex neural network architectures, enabling the integration of both content-based and collaborative approaches to improve recommendation performance.

Natural Language Processing (NLP) and Semantic Search

Natural Language Processing (NLP) techniques are essential for understanding and matching the textual data in job descriptions and candidate profiles. Unlike traditional keyword matching, NLP enables the system to interpret the meaning and context behind the text, offering more relevant job recommendations. Key NLP techniques include tokenization and lemmatization, which help clean and preprocess the text data. Additionally, semantic search allows for context-based job recommendations, ensuring that job matches are based on the underlying meaning of the descriptions rather than exact keyword matches. Libraries such as spaCy and NLTK are widely used for text preprocessing, while ElasticSearch provides a powerful platform for implementing semantic search, improving the accuracy of job matching.

Graph-Based Recommendation Systems

Graph-based recommendation systems represent jobs and candidates as nodes in a graph, with edges indicating relationships between them, such as shared skills or job interactions. This approach uncovers complex relationships that traditional methods may overlook. The construction of the graph involves representing jobs and candidates as nodes, with edges modeling relationships with weights reflecting the strength of these connections. Graph algorithms, such as collaborative filtering over graphs or community detection, are then applied to make job recommendations. Libraries like NetworkX provide tools for creating and analyzing complex networks, while PyTorch Geometric enables the integration of deep learning models with graph-based structures, supporting advanced graph-based recommendation techniques.

Transformer-Based Models (BERT, GPT-4)

Building on recent advances in NLP, transformer-based models such as BERT and GPT-4 are leveraged to enhance the semantic understanding of job descriptions and candidate profiles. These models are capable of analyzing text in a highly contextual manner, allowing for more precise job recommendations. Contextualized word embeddings generated by models like BERT and GPT-4 improve the understanding of the full context of words in sentences, enabling the system to recommend jobs based on meaning rather than exact keyword matches. The Hugging Face Transformers library is used to access pre-trained models like BERT and GPT-4, which can be fine-tuned for specific job recommendation tasks, providing a powerful tool for enhancing recommendation quality. By employing these cutting-edge techniques and libraries, the proposed AI-powered job recommendation platform is able to provide accurate, contextually relevant, and personalized job matches for candidates, addressing the common limitations found in traditional job matching systems.

Conclusion

This project aims to provide a more inclusive job matching process by combining AI-enabled components such as machine learning-based recommender systems, intelligent search engines based on profile analysis, and online interaction features. Machine learning recommender systems play a critical role in providing optimal matches by deeply analyzing candidate profiles and employer requirements. AI-powered search engines provide more accurate results by analyzing the semantic meaning of users' search queries, making it easier for candidates to access the most suitable job opportunities. Furthermore, the online interaction and support features provided by the platform facilitate more direct communication between candidates and employers, making the job search process transparent and user-friendly. The findings of the literature review suggest that the proposed platform can provide a structure where employers can reach the right candidates while candidates can better express their social and professional competencies. The project aims to create a fairer, impartial and efficient system in the labor market by prioritizing the user experience. This approach has the potential to create a more comprehensive transformation in the labor market by focusing not only on technical competencies but also on factors such as candidates' work culture and team dynamics. As a result, this project is positioned as an important step in the development of the next generation of AI-powered job matching platforms and offers a structure where users can fully demonstrate their personal skills. Future research can deepen the integration of AI into employment processes by analyzing the impact of such platforms on the job market in more detail. With this project, employers will have easier access to the right candidates, while candidates will have the opportunity to access the most suitable opportunities in their careers.

3. Software Requirements Specification

1. INTRODUCTION

1.1 Purpose

The purpose of this document is to provide a comprehensive specification for the Job Application and Matching Platform. This platform is designed to facilitate seamless interaction between job seekers and employers by leveraging AI-powered job recommendations and an intuitive user interface. This document outlines the system's requirements, functionalities, and design, serving as a reference for developers, stakeholders, and end-users.

1.2 Scope of Project

The Job Application and Matching Platform aims to simplify the hiring process by connecting job seekers with potential employers through intelligent recommendations. The system will include features such as user registration, profile management, job searches, AI-based matching, messaging, and interview scheduling. The platform will cater to two primary user groups: job seekers and employers. It is intended to enhance efficiency in the recruitment process while ensuring a user-friendly experience.

1.3 Glossary

Term	Definition
Job Seeker	An individual searching for job opportunities through the platform.
Employer	A company or individual seeking candidates for job positions via the platform.
AI Matching	Artificial intelligence algorithms used to recommend suitable jobs or candidates.
Dashboard	A user-specific interface displaying relevant information and tools.
Profile Management	The process of creating, updating, or managing user details within the system.
KVKK/GDPR	Data privacy regulations ensuring user data protection and rights.

1.4 References

- **GDPR**: General Data Protection Regulation (EU) 2016/679.
- **KVKK**: Kişisel Verilerin Korunması Kanunu (Turkish Personal Data Protection Law).

1.5 Overview of the Document

This document is divided into four main sections:

1. **Introduction**: Provides an overview of the platform, including its purpose, scope, and related definitions.
2. **Overall Description**: Details the platform's architecture, methodology, and user characteristics.
3. **Requirements Specification**: Specifies functional, non-functional, and system interface requirements.
4. **References**: Lists resources and documents referenced in the development of this specification.

2. OVERALL DESCRIPTION

2.1 Product Perspective

The Job Application and Matching Platform is designed as a web-based system to enhance the recruitment process for both job seekers and employers. The platform incorporates AI algorithms to offer personalized job recommendations and candidate matches based on user profiles, preferences, and activity history.

The platform is divided into several modular components, including user registration, profile management, AI-based job matching, a messaging system, and an interview scheduling tool. Each component is interlinked to create a cohesive user experience while maintaining flexibility for future enhancements.

2.1.1 System Context

The platform operates as a standalone web application accessible via modern web browsers. The system integrates with:

- **Third-party APIs** for email verification, notifications, and data enrichment.
- **AI algorithms** that analyze job seeker and employer data to provide intelligent matching.
- **Secure database systems** for storing user profiles, job postings, and activity logs.

2.1.2 System Boundaries

The system will not manage payment processing or third-party background checks. Such functionalities will require external integration in future versions.

2.1.3 Development Methodology

The project will follow the **Scrum Agile Development Methodology** [1], enabling iterative development and continuous feedback. Key features of this methodology include:

- **Sprints:** Dividing the development cycle into 2-3 week increments.
- **Daily Standups:** Regular team updates to address blockers.
- **Incremental Deliverables:** Delivering functional parts of the system for early validation by stakeholders.

2.2 User Characteristics

The platform is designed for two primary user groups:

2.2.1 Job Seekers

- **Characteristics:**
  - Typically individuals with varied skill levels in using online tools.
  - May include students, professionals, and individuals seeking career changes.
- **Requirements:**
  - Intuitive interface for creating and updating profiles.
  - Easy-to-use search and filtering options for job recommendations.
  - Real-time messaging with employers.

2.2.2 Employers

- **Characteristics:**
  - Individuals or HR representatives from companies of various sizes.
  - Familiarity with digital tools but may vary in technical expertise.
- **Requirements:**
  - Tools for creating and managing job advertisements.
  - Efficient access to the resume pool and candidate profiles.
  - Scheduling features for interviews and candidate tracking.

2.2.3 Administrators

- **Characteristics:**
  - System administrators managing the platform's operations.
  - Technically skilled in troubleshooting, managing servers, and maintaining data integrity.
- **Requirements:**
  - Access to system logs and analytics.
  - Tools to manage user accounts and permissions.

2.3 Operating Environment

- **Client-Side Environment:**
  - o Users will access the platform using modern web browsers on desktops, tablets, or mobile devices.
  - o Supported browsers include Google Chrome, Mozilla Firefox, Microsoft Edge, and Safari.

- **Server-Side Environment:**
  - o The platform will run on a cloud-based infrastructure, using Linux servers for hosting.
  - o The system will utilize PostgreSQL for data storage and Java Spring Boot for backend services.

2.4 Design and Constraints

- **Design Goals:**
  - o Ensure seamless navigation and responsiveness across devices.
  - o Enable scalable architecture to accommodate growth in user base.

- **Constraints:**
  - o Initial deployment will support only Turkish and English languages.
  - o AI-based recommendations will be limited to analyzing 2,000-4,000 user profiles during the initial phase.
- o Security protocols must comply with GDPR and KVKK standards.

2.5 Assumptions and Dependencies

- Users will have stable internet access to use the platform.
- Job seekers and employers are expected to provide accurate and up-to-date profile information.
- The recommendation system's efficiency depends on the quality and quantity of the data provided by users.

3. REQUIREMENTS SPECIFICATION

3.1 External Interface Requirements

This section outlines the required interfaces for the system to function effectively. The interfaces include user, hardware, software, and communication requirements, ensuring the system integrates smoothly into its operational environment.

3.1.1. User interfaces

The platform will provide a web-based user interface designed for both job seekers and employers. The key features of the user interface include:

- **Responsive Design:** The UI will adapt to different screen sizes, including desktops, tablets, and mobile devices, ensuring accessibility across various devices.
- **Login and Registration Forms:** Clear and simple forms for users to register, log in, or recover their credentials.
- **Dashboard:** Personalized dashboards for job seekers and employers to access their respective functionalities.
- **Interactive Components:** Features such as job search filters, AI-suggested matches, and a messaging system will utilize intuitive and interactive UI elements.
- **Multi-language Support:** The interface will support English and Turkish languages initially, with potential for expansion based on user needs.

3.1.2. Hardware interfaces

The platform requires standard hardware setups for both end users and the hosting environment:

- **End User Devices:** The system is optimized for devices capable of running modern web browsers, including PCs, laptops, tablets, and smartphones.
- **Server Requirements:** The backend servers must support Java Spring Boot applications and PostgreSQL databases, with recommended minimum hardware specifications:

  Hardware Requirements
  - **Processor (CPU):** A dual-core processor (for example, Intel Core i3 or AMD Ryzen 3) or better.
  - **Memory (RAM):** Minimum 4 GB RAM. 8 GB RAM is recommended for better performance, especially when using multiple tabs.
  - **Storage:** Minimum 2 GB free space for local storage (for browser cache and temporary files).
  - **Screen Resolution:** Minimum 1280x720 (HD) screen resolution. 1920x1080 (Full HD) is recommended for a better user experience.
  - **Graphics Card:** The built-in graphics card is sufficient (for example, Intel HD Graphics).

3.1.3. Software interfaces

The software interfaces include:

- **Operating System:** The system is compatible with Linux and Windows environments for server deployment.
- **Browser Compatibility:** The platform supports Google Chrome, Mozilla Firefox, Microsoft Edge, and Safari. Other browsers may work but are not officially supported.

- **Third-Party Libraries:** Integration with libraries and APIs such as Material-UI for front-end design, ElasticSearch for search functionality, and AI algorithms via Python Sklearn.
- **Email Services:** Integration with third-party email services like Gmail or AWS SES for email verification and notifications.

3.1.4. Communications interfaces

Communication between the platform's components and external systems will follow standard protocols to ensure reliability and security:

- **API Communication:** RESTful APIs will be used for all system interactions, with endpoints secured using OAuth 2.0.
- **Database Communication:** PostgreSQL will serve as the database system, communicating with the backend via JDBC.
- **Message Notifications:** A notification system will utilize WebSocket for real-time updates.
- **Security Protocols:** All communications will use HTTPS, with data encrypted using TLS 1.2 or higher.
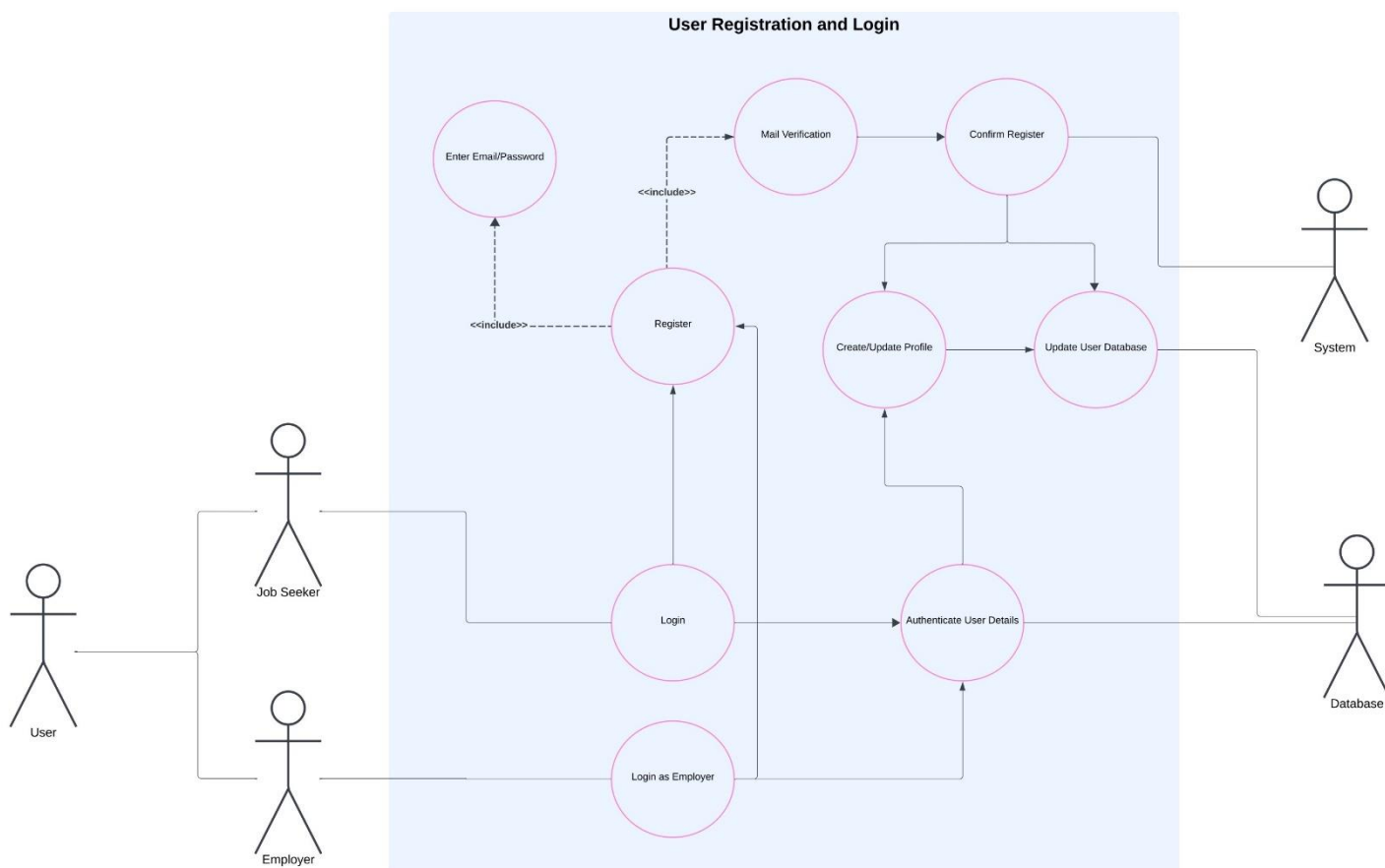
3.2 Functional Requirements

3.2.1. User Registration and Login Use Case

Use Case:

- Login
- Login as Employer
- Authenticate User Details
- Create/Update Profile
- Register
- Enter Password/ Email
- Mail Verification
- Confirm Register
- Update User Database

Diagram:

<u>**Brief Description:**</u>

In User Registration and Login diagram explains the steps of employer and jobseekers' registration, login and create profile operations. Users can use the following functions: Email and password authentication, Mail verification, and Profile creation/update.

Initial Step by Step Description:

User Registration

1. A user (either a job seeker or an employer) accesses the registration page.

2. The user inputs their email address and password.

3. The system sends a verification email to the provided email address.

   3.1. If user does not click on the verification link to confirm their email user should re- register.

4. After confirming, the user proceeds to create or update their profile with additional details.

5. The system saves the user's details in the database.

User Login

1. User accesses the login page or login as employer page.

2. The user inputs their email and password to log in.

3. The system verifies the credentials against the database.

   3.1. If the credentials are valid, access is granted.

   3.2. If the user logs in as an employer, they are directed to a specific interface.

   3.3. If the user logs in as a job seeker, they are directed to a different interface.

3.2.2. The Menu Use Case for Employer and Job Seeker

Use Case:

- Manage Profile
- View Chat and Schedule Appointment
- View Blog Page
- Create Blog
- Search Jobs
- Manage Messages and Notifications
- View Jobs
- Manage Interviews
- View Resume Pool
- Manage Advertisement

Diagram:

The Menu

Manage Profile

View Chat and Schedule Appointment

View Blog Page

<<extend>>

Search Jobs

Create Blog

View Resume Pool

View Jobs

Manage Advertisement

Job Seeker

Employer

Manage Messages and Notifications
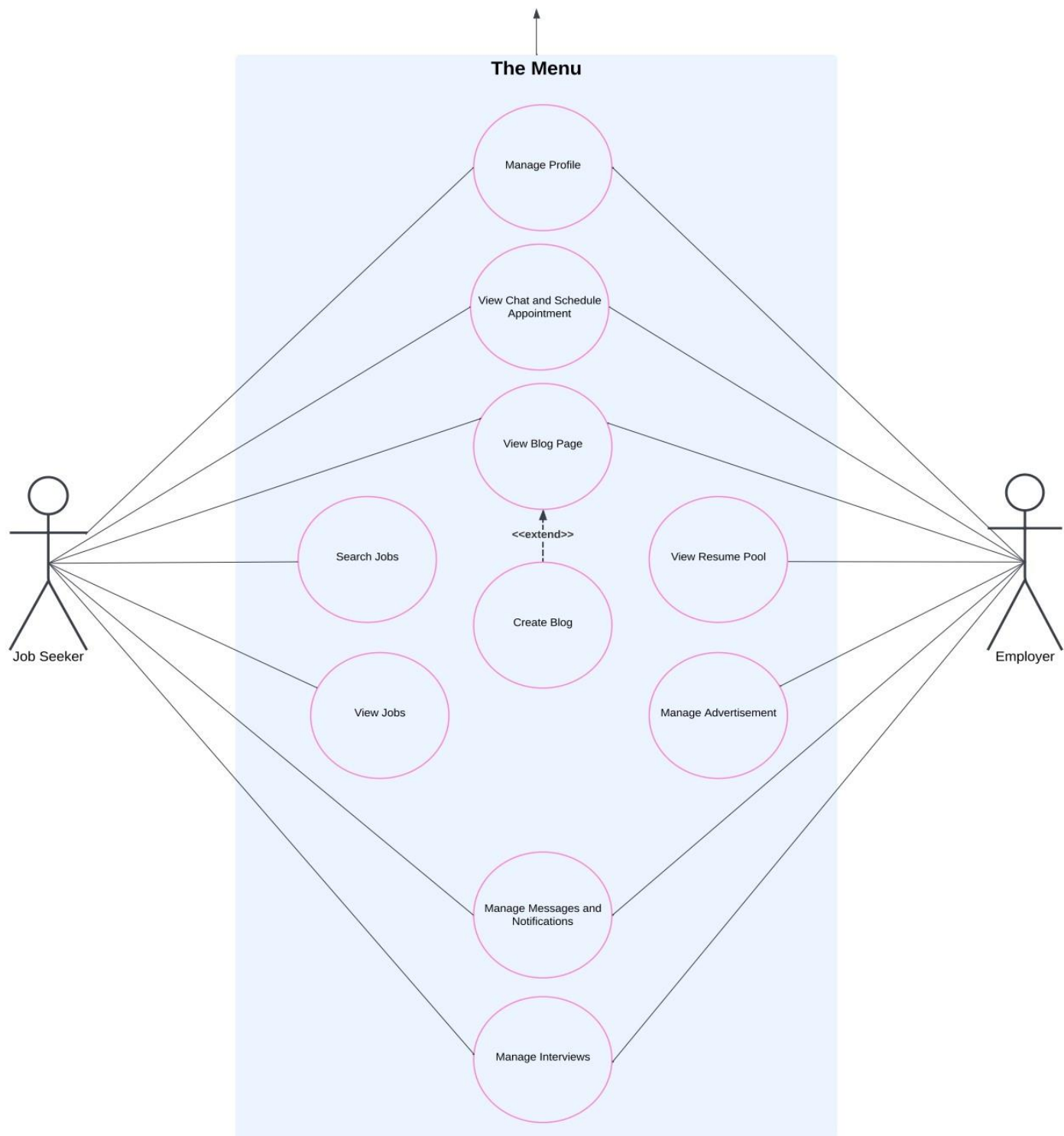
Manage Interviews

Brief Description:

The Menu diagram represents the functionalities of how users (either a job seeker or an employer) can manage profiles and use features like job search, resume management, blogs, manage interviews, view resume pool, manage job advertisements and notifications.

Initial Step by Step Description:

Job Seeker

1. A job seeker accesses the menu page.

    1.1. Job seekers can create, update, or delete their profiles through the menu.

    1.2. Job seekers search for jobs based on specific criteria or review detailed job descriptions of potential positions.

    1.3. Job seekers can see their applications, reviewed and saved advertisements.

    1.4. Job seekers can reach scheduled and managed interviews with employers.

    1.5. Job seekers can chat with employers and schedule appointments for interviews or discussions.

    1.6. Job seekers can access the blog page for industry news or tips, written by employers.

Employer

1. An employer accesses the menu page

    1.1 Employers create or update company profiles to showcase their brand and opportunities.

    1.2. Employers can browse a database of resumes to find suitable candidates.

    1.3. Employers create and manage advertisements for job openings.

    1.4. Employers contribute blogs to engage job seekers or share insights.

   1.5 Employers chat with job seekers and schedule discussions or interviews.

3.2.3. AI Job Matching System Use Case

Use Case:

- Search Job
- Review Job Suggestions
- Apply for a Job
- Save Application
- Manage Advertisement
- Post Job Advertisement
- View Job Advertisement
- Edit Job Advertisement
- Review Incoming Applications
- Review Candidate Suggestions
- Search Resume Pool
- Filter Suitable Candidates
- Track Candidates
- Make an Offer
- Set Candidates
- Reject
- Rejected Ones Undo
- View my offers
- Set Alarm
- Match Candidates/Jobs

Diagram:
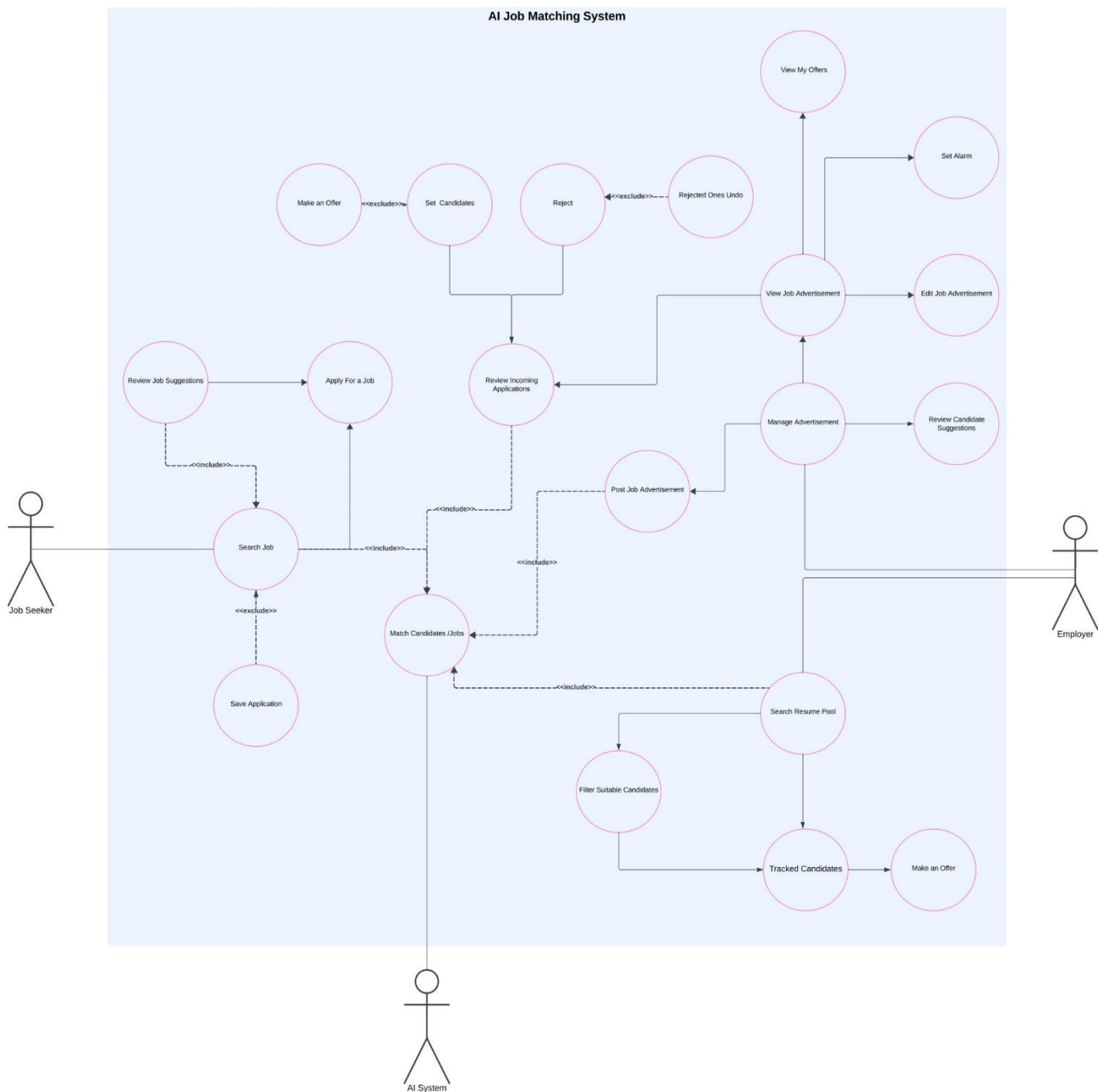
Brief Description:

AI job matching system diagram outlines the interaction between job seekers, employers, and an The AI system facilitates automated matching between candidates and jobs based on profiles, applications, and advertisements. Job seekers focus on finding and applying for jobs, while employers manage advertisements, review applications, and offer jobs to selected candidates.

Initial Step by Step Description:

Job Seeker

1. The job seeker initiates a job search by entering their preferences.
2. The AI system generates a list of suggested jobs based on the job seeker's profile, preferences, and skills.
3. The job seeker selects a job from the suggestions and submits their application to the employer via the system.
4. The job seeker can save an application for later reference if they want to finalize or track it in the future.

Employer

1. The employer creates and posts a job advertisement specifying job title, description, skills, and qualifications.
2. The employer can edit, update, or delete the job advertisements if needed.
3. Employers can search the resume pool to identify suitable candidates using filters.

    3.1. The AI system filters and displays a list of the most relevant candidates based on the job requirements.

    3.2. Employers can track candidates they are interested in or wish to consider further.
4. Employers review job applications submitted by job seekers and evaluated the suitability of candidates which filtered by AI system.

    4.1.The employer can make a job offer to a selected candidate or reject unsuitable applications.

    4.2.The employer can undo a rejection from the list of rejected candidates.
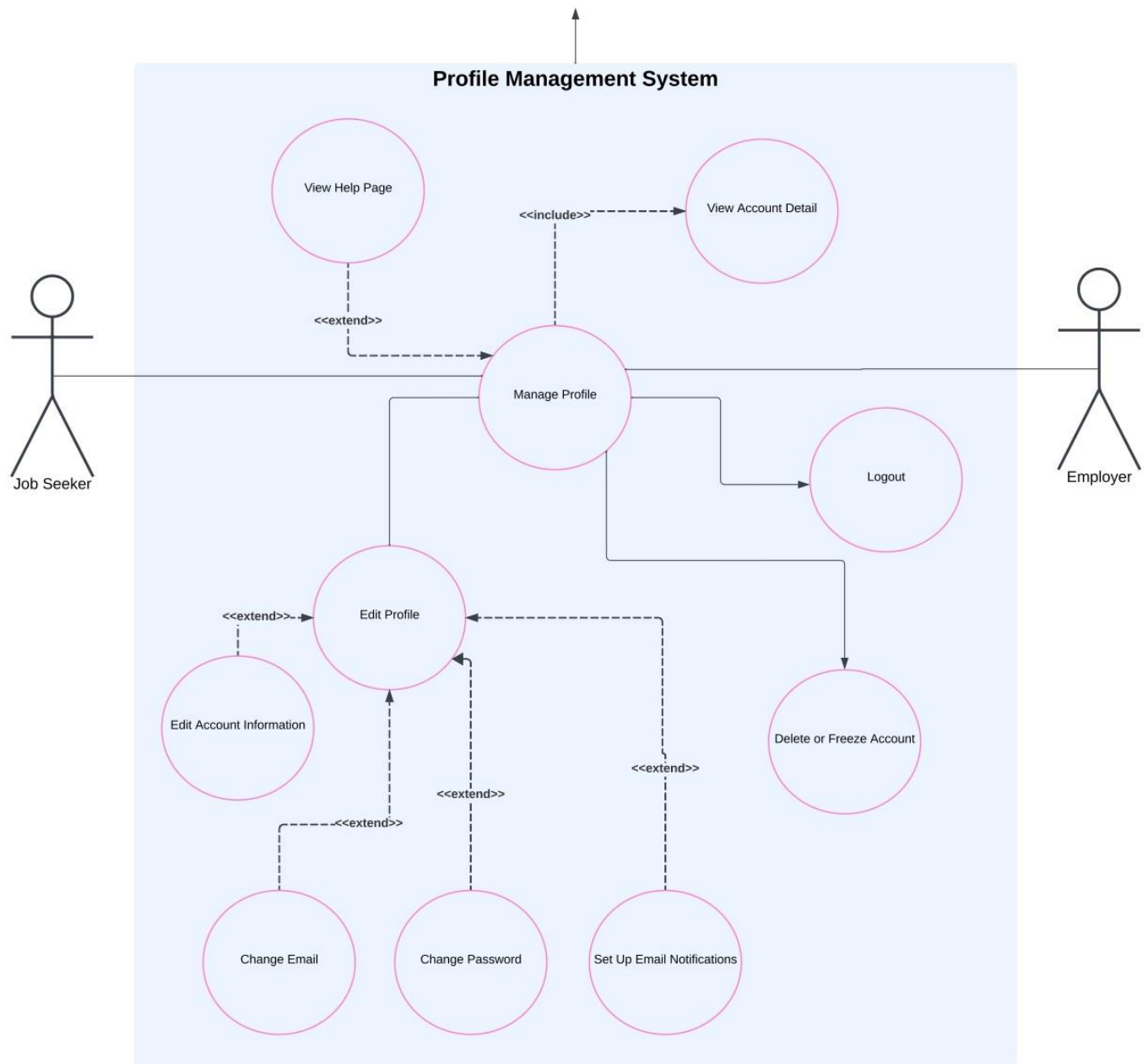
AI System

1. The AI system analyses job seeker profiles and matches them with job advertisements using algorithms that consider skills, experience, and preferences.
2. The AI generates a ranked list of suggested candidates for employers based on job requirements.
3. The AI produces a ranked list of job recommendations for job seekers based on their profiles and preferences.
4. The AI system filters the job seekers based on the selected features by employers.
5. The AI system uses feedback to refine its matching algorithms.

3.2.4. Profile Management Use Case

Use Case:

- Manage Profile
- View Help Page
- View Account Detail
- Edit Profile
- Edit Account Information
- Change Email
- Change Password
- Set Up Email Notifications
- Delete or Freeze Account
- Logout

Diagram:

Profile Management System

Brief Description:

Profile Management System Diagram represents the functionalities for two primary actors: Job Seeker and Employer. The system enables users to manage their profiles, view account details, edit profile settings, and perform other account-related operations such as logging out or setting up email notifications.

Initial Step by Step Description:

1. A user (either a job seeker or an employer) accesses the menu page.
2. User selects the manage profile option.

   2.1. User can select Edit Profile for options to edit account information, change email, set up email notifications or change password.

   2.2. User can see account details.

   2.3. User can select View Help Page for help.

   2.4. If user selects Delete or Freeze Account, and if the user confirms, the account is either deleted or frozen as per the selection.

   2.5. If user selects Logout, the system ends the user session and redirects them to the login page.

3.3 Performance Requirement

This section defines the performance requirements that the system must meet to ensure a seamless and efficient user experience.

3.3.1 System Response Time

- **Search Operations:** o Job searches using filters and AI recommendations must return results within **1-2 seconds**.
- **Page Transitions:** o Navigating between pages, such as "Job Matches" or "Messages," must be completed within **1 second**.
- **Messaging Feature:** o Real-time messaging should deliver and display messages within **500 milliseconds**.

3.3.2 Scalability

- **Concurrent Users:** o The system must support up to **500 simultaneous users**.
- **Data Storage:** o The system must be optimized to handle **5,000 job postings** and **10,000 user profiles**.
- **System Expansion:** o The system should be expandable both horizontally (adding servers) and vertically (increasing existing server resources) to accommodate user growth.

3.3.3 Availability

- **Uptime:** o The system must maintain **99% uptime**, allowing a maximum of **7 hours of downtime** per month.

3.3.4 Load Management

- **Load Capacity:** o The system must process up to **100 job searches per minute** and **50 simultaneous chat connections** without interruptions.
- **Profile Updates and Operations:** o Profile updates or job posting operations should not exceed **5 seconds**.

3.3.5 Error Handling and Recovery

- **Failure Recovery:** o In the event of a system crash, services must be restored within **2 minutes**.
- **Session Management:** o User sessions should remain active for **15 minutes** of inactivity and resume within **2 seconds** when the user performs an action.

3.3.6 AI Matching Efficiency

- **Processing Time:** o The AI-powered job matching system should provide recommendations within **3 seconds**.
- **Training Data Capacity:** o The AI algorithm should be trainable with **2,000 to 4,000 user profiles**.

3.3.7 Resource Utilization

- **Server Resource Usage:** o CPU usage should not exceed **70%** under normal operations and **85%** under peak load. o Memory usage should remain stable at **75%**.

3.4 Software System attributes

This section defines the general characteristics that a software system should have. The system must be efficient, reliable, and sustainable to meet the needs of its users.

3.4.1 Portability

- The system should function seamlessly on various web browsers (e.g., Google Chrome, Mozilla Firefox, Microsoft Edge).
- On the server side, the system must be capable of running on both Windows and Linux operating systems.
- It should operate without requiring additional software installation on user devices; only an internet connection and a web browser are sufficient.

3.4.2 Performance

- The system must be designed to support up to **500 simultaneous users**.
- Database queries (e.g., job searches, profile matches) should be completed within **2 seconds**.
- The messaging system should deliver messages within **500 milliseconds**.

3.4.3 Usability

- The user interface must be intuitive and easy to use for users of all skill levels.
- A functional and accessible design should be provided equally for both mobile devices and desktop computers.
- Menus, features, and operations should be easily accessible through a user-friendly navigation system.

3.4.4 Adaptability

- The system should be scalable to accommodate a growing user base or the addition of new features.
- New functionalities must be integrated without disrupting the existing system.
- It should be adaptable to local markets or different language requirements (initially supporting Turkish and English).

3.4.5 Reliability

- The system must guarantee **99% uptime** and avoid downtime except for scheduled maintenance.
- Errors and issues should be minimized, and any occurring problems should be resolved automatically without disrupting the user experience.

3.4.6 Security

- User data must be safeguarded using encryption protocols (e.g., HTTPS and TLS 1.2 or higher).
- Database access should be restricted to authorized users only.
- Strong password policies and two-factor authentication should be implemented for user accounts.

3.4.7 Scalability

- The system must support horizontal scaling (adding servers) and vertical scaling (upgrading hardware) to accommodate increases in user base.
- The database should effectively manage up to **10,000 user profiles** and **5,000 job postings**.

3.4.8 Maintainability

- The codebase should be well-organized and interpretable to facilitate future maintenance and updates.
- A version control system (e.g., Git) must be utilized to track and manage code changes.
- Issues should be quickly identified and resolved through logging and error reporting systems.

3.5 Safety Requirement

This section defines the precautions and security requirements necessary to ensure the safe usage of the system.

3.5.1 Data Security

- All user data (e.g., passwords, email addresses, profile information) must be encrypted while stored in the database.
- Data transmission must use secure encryption protocols, such as TLS 1.2 or higher.
- To prevent unauthorized access, optional two-factor authentication (2FA) should be offered for user accounts.

3.5.2 System Access Control

- Only authorized users should have access to specific data or system functionalities.
- Administrative privileges must be restricted to users responsible for critical system changes.
- User sessions should automatically terminate after **15 minutes** of inactivity.

3.5.3 Data Backup

- All user data and job-related information must be backed up daily and securely stored for a minimum of **30 days**.
- In case of data loss, the system should be restored from backups within a maximum of **2 hours**.

3.5.4 Software Errors and Recovery

- In case of a software crash, the system should automatically restart after analyzing error logs.
- Users should be informed of system status with a notification and allowed to continue their operations seamlessly.
- Temporary storage should be used to prevent data loss during faulty operations.

3.5.5 User Privacy

- User data must not be shared with third parties without explicit consent.

- Users must have the ability to view, edit, or delete their account information (compliance with GDPR/KVKK)[2].

- User activity should only be tracked anonymously for performance improvements and error detection.

3.5.6 Physical Security

- Server hardware must be hosted in secure data centers that:
- Are climate-controlled.
- Are equipped with uninterrupted power supply (UPS) and fire suppression systems.
- Have measures in place to prevent unauthorized physical access.

3.5.7 Risk Management

- Potential security vulnerabilities should be tested regularly (e.g., through penetration testing), and necessary patches should be applied.

- In case of an attack (e.g., DDoS), traffic should be temporarily restricted, and a pre-defined crisis management plan should be implemented.

- Email verification systems (e.g., SPF, DKIM, DMARC) should be enabled to prevent phishing attempts.

3.5.8 Emergency Plans

- In the event of a critical system failure, a static maintenance page should be activated to guide users.

- Backup and recovery plans must be tested regularly to ensure their functionality.

4. Software Design Description

1. INTRODUCTION

1.1 Purpose

The purpose of this Software Design Document (SDD) is to provide a detailed, structured, and comprehensive blueprint for the **Job Application and Matching Platform**. This document serves as a foundational reference for all stakeholders, including developers, quality assurance teams, project managers, and end-users. It ensures alignment on project objectives, outlines the technical framework, and delineates the features and functionality of the system.

The platform is specifically designed to transform and enhance the hiring process within the computer engineering sector. By leveraging cutting-edge AI algorithms, it connects job seekers with roles that suit their technical and interpersonal skillsets while simultaneously helping employers find candidates who match their requirements effectively. This approach addresses existing gaps in the job-matching landscape, focusing on inclusivity, fairness, and efficiency.

In addition to bridging the gap between candidates and employers, this document emphasizes best practices in software design, ensuring that the platform is robust, scalable, and secure. The insights presented in this document form the basis for seamless system implementation and long-term maintenance.

1.2 Scope

The scope of this project encompasses the design and development of a web-based job-matching platform that delivers tailored solutions to both job seekers and employers in the computer engineering sector. The platform's primary features include:

- **Comprehensive Profile Analysis**: Advanced AI tools analyze users' profiles, including their academic credentials, work experience, technical expertise, and interpersonal skills.
- **Job Recommendation System**: AI algorithms match candidates to jobs and jobs to candidates based on user-defined preferences and requirements.
- **Enhanced User Support**: Integrated live support ensures prompt assistance with user queries and technical issues.

Key deliverables include:

- A robust registration and login system.
- Intuitive dashboards for job seekers and employers.
- AI-driven recommendations that enhance decision-making.
- Support for secure and GDPR-compliant data management practices.

The platform serves two core user groups:

1. **Job Seekers**: Encompassing individuals from varied professional backgrounds, including students, early-career professionals, and seasoned engineers.

2. **Employers**: Ranging from small startups to large organizations seeking top talent.

The solution is highly customizable, ensuring its adaptability to evolving industry demands and user needs.

1.3 Glossary

Term	Definition
Job Seeker	An individual searching for employment opportunities through the platform.
Employer	A company or individual posting job advertisements and searching for candidates.
AI Matching	Artificial intelligence algorithms used to recommend jobs or candidates.
Dashboard	A personalized interface for users to access relevant tools and information.
Profile Management	The ability for users to create, update, and manage their profiles.
KVKK/GDPR	Regulations ensuring user data privacy and security (General Data Protection Regulation / Turkish Personal Data Protection Law).
Live Support	A real-time assistance feature provided to users for troubleshooting.
Candidate Pool	A database of job seekers accessible to employers for recruitment purposes.
Recommendation System	An AI-based feature that analyzes user preferences to provide job or candidate suggestions.

1.4 Overview of Document

This Software Design Document is organized into the following sections:

- **Introduction**: Establishes the purpose, scope, glossary, and motivation for the platform.
- **Architecture Design**: Describes the high-level system architecture, including the technologies used and design patterns adopted.
- **Use Case Realizations**: Explains key functionalities of the system, supported by diagrams and scenarios.
- **Environment**: Details the technical and operational environment, including tools and frameworks used in development.
- **References**: Provides a comprehensive list of standards, technologies, and documents referenced during the project.

Each section builds upon the others to provide a thorough understanding of the system's design and implementation, ensuring clarity and completeness for all stakeholders.

1.5 Motivation

Traditional job platforms often prioritize technical qualifications and academic credentials, neglecting essential factors such as soft skills, cultural fit, and professional experiences. These limitations often lead to mismatches between job seekers and employers, increasing hiring time and costs.

This platform seeks to address these issues by offering:

- **A Holistic Evaluation Process**: By incorporating both technical and interpersonal skill assessments, the platform ensures a better fit for both candidates and employers.
- **Efficient Hiring Mechanisms**: Features like AI-driven recommendations, real-time messaging, and appointment scheduling streamline the recruitment process.
- **Increased User Satisfaction**: Job seekers gain access to more relevant opportunities, while employers can easily identify and engage with suitable candidates
- **Adherence to Privacy Standards**: The platform is designed to comply with GDPR and KVKK, ensuring secure handling of user data.

By addressing these challenges, the **Job Application and Matching Platform** aims to redefine the hiring process within the computer engineering sector. Its innovative features and user-centric design ensure a transformative impact on the recruitment landscape, promoting fairness, transparency, and efficiency.

2. ARCHITECTURE DESIGN

The project follows a layered architecture approach, which enhances modularity, scalability, and maintainability. Each layer has a distinct responsibility, ensuring that the system is well-organized and easy to extend.

2.1 Core Architecture Design

1. **Core Layer:**
   o The Core Layer contains fundamental components and definitions used across the project, ensuring consistency and reducing code duplication.

2. **Entity Layer:**
   o The Entity Layer defines data models mapped to database tables using JPA, serving as the backbone for business operations.

3. **Business Layer:**
   o The Business Layer manages core business logic, acting as an intermediary between the Entity Layer and the Presentation Layer. It ensures consistent application of business rules and correct data processing.

4. **Presentation Layer:**
   o The Presentation Layer, developed using React.js, provides a dynamic and responsive user experience, interacting with backend services via RESTful APIs.

5. **Database Layer:**
   o The Database Layer, powered by PostgreSQL, is optimized for complex queries and ensures data integrity through enforced constraints and relationships [3]

6. **External APIs and Services:**
   o The system integrates with external services such as AWS SES, Gmail API for email notifications, ElasticSearch for advanced search capabilities [6], and WebSocket for real-time communication.

7. **Deployment Environment:**
   o The deployment environment leverages cloud platforms like AWS or Google Cloud for scalability and high availability, with Docker ensuring consistent deployments.
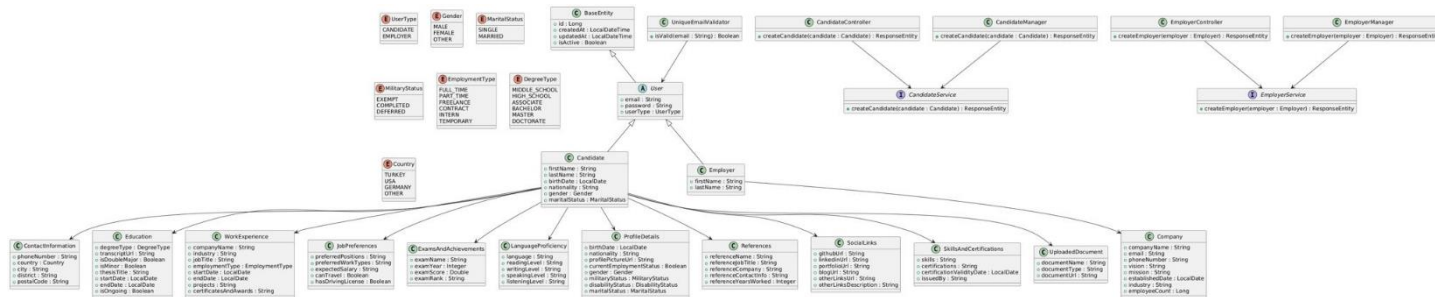
This architecture ensures a robust, scalable, and maintainable system, capable of supporting future growth and feature additions.

Class Diagram 1
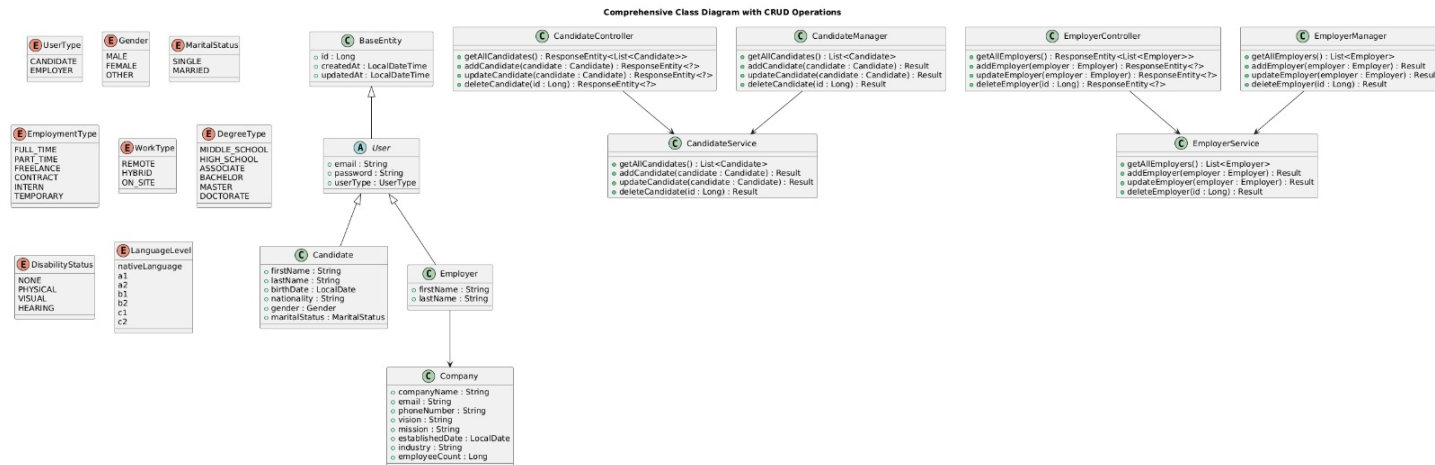
To view the diagram more clearly, you can <u>download the PNG file here</u>.

Class Diagram 2

To view the diagram more clearly, you can <u>download the PNG file here</u>.

2.2 Deployment Architecture Design

The architecture comprises the following main components:

1. **Frontend (Presentation Layer):**
   - Developed using React.js for dynamic and responsive user interfaces.
   - Implements Material-UI for consistency in design and enhanced user experience.
   - Interacts with the backend via RESTful APIs.

2. **Backend (Application Layer):**
   - Built on Java Spring Boot, ensuring robust and scalable API management.
   - Incorporates business logic for user management, job matching, and real-time messaging.
   - 0Integrates with AI modules written in Python for advanced recommendation algorithms.

3. **Artificial Intelligence Module:**
   - o Utilizes Python libraries like PyTorch, Keras, Scikit-learn and TensorFlow for job and candidate matching.
   - o Employs collaborative filtering, content-based filtering, and hybrid recommendation approaches.
   - o Continuously improves through machine learning models trained on user interactions.

4. **Database (Data Layer):**
   - o Powered by PostgreSQL, optimized for complex queries and data integrity.
   - o Stores user profiles, job postings, application records, and AI-generated recommendations.
   - o Ensures data redundancy and backups for reliability.

5. **External APIs and Services:**
   - o Email verification and notification services through AWS SES or Gmail APIs.
   - o Search functionalities enhanced by ElasticSearch for efficient information retrieval.
   - o WebSocket protocol for real-time messaging between users.

6. **Deployment Environment:**
   - o Hosted on cloud platforms like AWS or Google Cloud for scalability and high availability.
   - o Implements containerization with Docker for consistent deployments across environments.

This deployment architecture ensures a seamless experience for users while maintaining a robust and flexible backend to support future growth and feature additions.

2.3 Activity Diagram
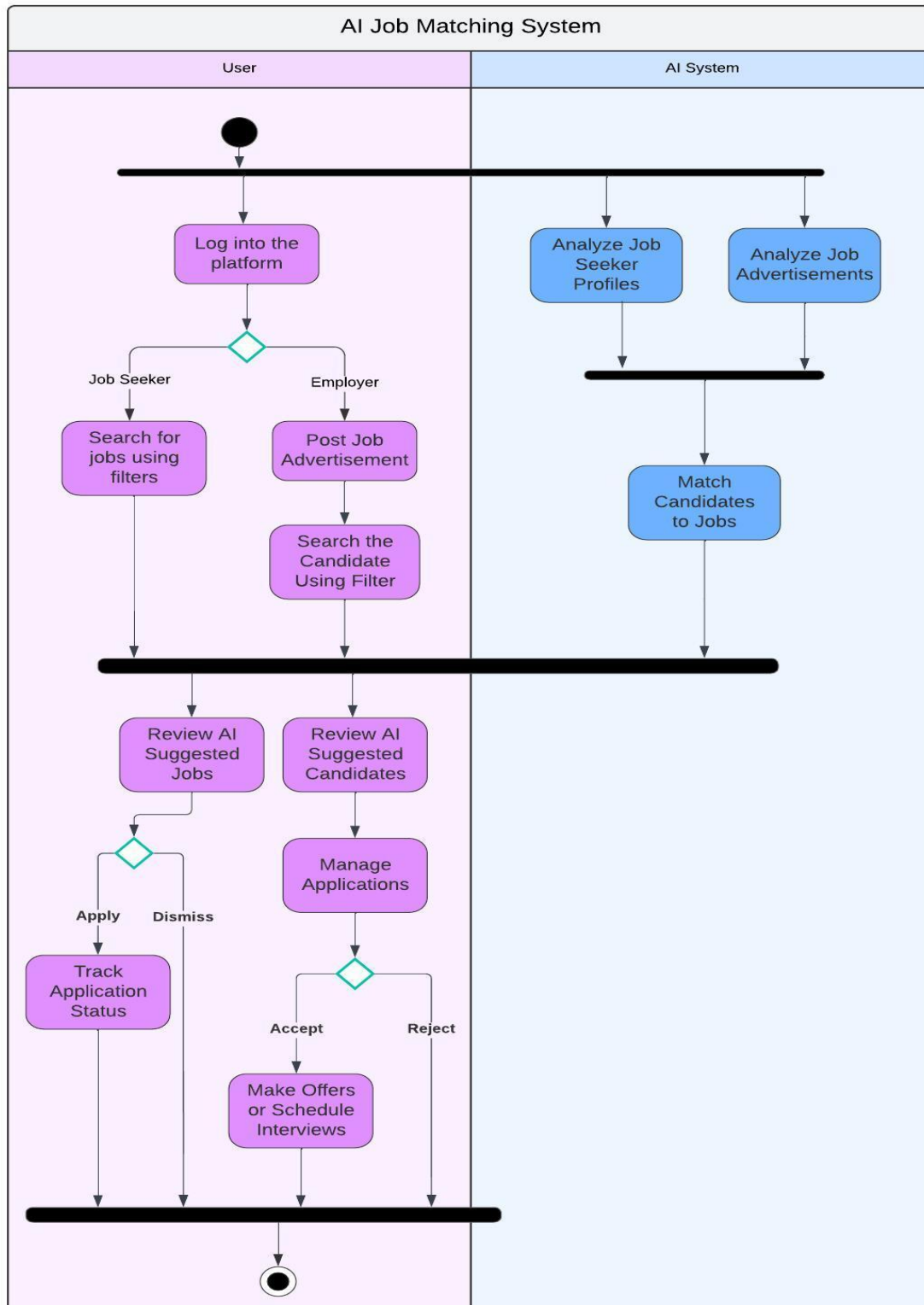
In this activity diagram describes an interactive process between a Job Seeker, Employer, and AI System. The Job Seeker begins by logging into the platform and searching for jobs using various filters. After reviewing AI-suggested jobs, the job seeker selects and applies for a job, then tracks the application status. The Employer, on the other hand, posts job advertisements detailing necessary skills and qualifications and searches the candidate's using filters. The employer reviews AI-suggested candidates, manages applications by accepting or rejecting candidates, and may make offers or schedule interviews. The AI System plays a central role by analysing job seeker profiles, including their skills, experience, and preferences, while also analysing job postings to understand required skills. The AI system matches candidates to jobs by generating a ranked list of suitable candidates and provides feedback to continuously improve the accuracy of its recommendations, ensuring that both job seekers and employers find the best fit for each other.

3. USE CASE REALIZATIONS
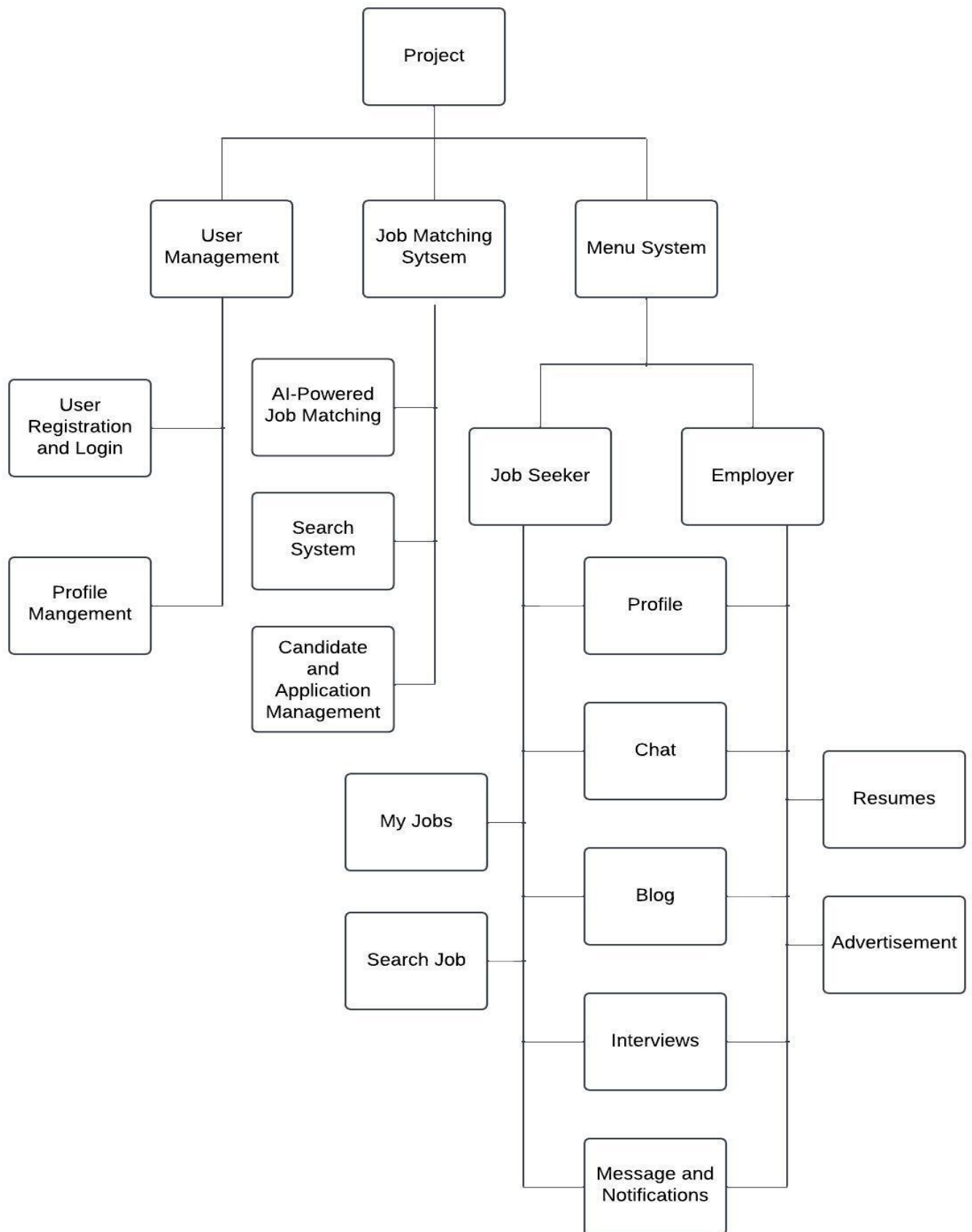
3.1 Brief Description

Components of the project are shown in the figure above. All designed systems of the project are displayed in the block diagram in the figure. There are three main components of the system which have their own sub-systems, organized hierarchically to reflect the structure and functionality of the project.

3.1.1 User Management

This component focuses on user-related operations, including registration, login, and profile management. It enables users to create accounts, authenticate credentials, and manage their profiles efficiently. Features include email verification, account updates, and the ability to freeze or delete accounts, ensuring secure and personalized user experiences.

3.1.2 Job Matching System

The Job Matching System is the core feature of the platform, utilizing AI algorithms to connect job seekers with suitable job opportunities and employers with the most relevant candidates. It allows job seekers to search for positions, view AI-generated recommendations, apply for jobs, and save applications for later reference. Employers can manage advertisements, search for candidates, and track applications efficiently. The system ensures high accuracy in recommendations by analyzing user profiles, preferences, and job requirements. It provides a dynamic and automated way to streamline the hiring process, reducing time and effort for both parties.

3.1.3 Menu System

The Menu serves as the central hub for accessing all major functionalities of the platform, customized for two primary user groups: job seekers and employers. Job seekers can manage their profiles, view job applications, access saved jobs and communicate with employers through real-time chat. They can also read blogs contributed by employers and schedule interviews directly from the platform. Employers, on the other hand, can manage resumes, create job advertisements, and interact with potential candidates. Notifications and messages are integrated into the menu, ensuring users stay updated on critical actions and events. This component ensures an streamlined navigation experience for all users.

4. ENVIRONMENT

4.1 Modelling Environment

The **Modeling Environment** for the **Job Application and Matching Platform** encompasses all tools, frameworks, and platforms required to design, develop, and maintain the system effectively. The environment is tailored to ensure robust system performance, scalability, and user satisfaction. Key elements include:

1. **Development Tools:**
   - **Integrated Development Environments (IDEs):**
     - IntelliJ IDEA for backend development with Spring Boot.
     - Visual Studio Code for frontend development with React.js.
   - **Version Control:**
     - Git and GitHub for source code management and collaboration.
   - **Containerization:**
     - Docker for creating consistent development and deployment environments.

2. **Frameworks and Libraries:**
   - **Frontend Frameworks:** React.js with Material-UI for UI design.
   - **Backend Frameworks:** Java Spring Boot for creating APIs and managing business logic.
   - **AI Libraries:** Scikit-learn and TensorFlow for machine learning and recommendation algorithms.
   - **Database Management:** PostgreSQL for handling relational data efficiently.
   - **Search Engine:** ElasticSearch for enhanced job and candidate search capabilities.

3. **Deployment Environment:**
   - **Cloud Platforms:** AWS or Google Cloud for hosting scalable and secure infrastructure.
   - **Continuous Integration/Continuous Deployment (CI/CD):** Jenkins or GitHub Actions for automated testing and deployment.

4. **Testing Tools:**
   - **Unit Testing:** JUnit for backend testing and Jest for frontend testing.
   - **Integration Testing:** Postman and Selenium for API and UI testing.
   - **Load Testing:** Apache JMeter to simulate high user traffic and ensure system stability.

5. **Monitoring and Logging:**

   o **Monitoring Tools:** Prometheus and Grafana for real-time system monitoring.

   o **Logging:** Logstash and Kibana for tracking and visualizing system logs.

By leveraging this modeling environment, the development team ensures a streamlined process from initial design to final deployment, minimizing risks and optimizing resource utilization. The environment supports iterative development, rapid prototyping, and continuous improvement, aligning with agile methodologies and best practice.

5. Conclusion

This document provides a detailed overview of the AI-Powered Job Matching Platform, which was designed to address critical challenges in the recruitment process. The platform introduces a novel, AI-driven two-way matching system that evaluates candidates and job postings holistically, reducing biases and inefficiencies associated with traditional job platforms.

The project began with extensive research into existing job platforms and machine learning techniques. Based on the identified gaps and opportunities, we developed a scalable, modular architecture that incorporates advanced AI models, ensuring high relevance and accuracy in job matching. The use of familiar and proven technologies such as **Java Spring Boot**, **React.js**, **Python**, and **PostgreSQL** allowed the team to leverage their collective expertise in creating a robust and maintainable system.

Currently focused on the computer engineering sector, the platform is intended to expand into other industries, offering a standardized approach to job matching. Key features such as real-time interaction tools, personalized dashboards, and advanced search capabilities further enhance the user experience, making the platform a valuable tool for both job seekers and employers.

While the platform offers numerous advantages, including fairness, efficiency, and scalability, future work will focus on continuous improvement of the AI models, expanding industry coverage, and incorporating real-time user feedback. By addressing these areas, we aim to ensure that the platform remains at the forefront of recruitment technology.

In conclusion, the AI-Powered Job Matching Platform presents a comprehensive solution to the limitations of existing job platforms. With its innovative approach and commitment to fairness and efficiency, the platform has the potential to significantly improve the job search and hiring process, creating a more equitable and effective job market for all stakeholders.

Acknowledgement

References

[1] Marr, B. (2024, October 24). 4 AI-Powered Strategies for Your Ultimate Job Search. Forbes. https://www.forbes.com/sites/bernardmarr/2024/10/24/4-ai-powered-strategies-for-your-ultimate-job-search/

[2] Behrain, A. (2024, March 27). Creating an AI-Powered Job Recommendation System. Medium. https://medium.com/@abbasbehrain95/creating-an-ai-powered-job-recommendation-system-50ce1cd12d36

[3] Job Seeker Recommendation for Employers: A Graph-Based Recommendation Approach Using Node Embedding. (2024). Journal of AI and Machine Learning Applications. https://www.sciencedirect.com/science/article/pii/S1877050923015193

[4] Manzen, P. (2024). Job Recommendation Engine. GitHub https://github.com/patiencemanzen/job-recommendation-engine

[5] Panchasara, A., & Gupta, R. (2024). AI-Based Job Recommendation System using BERT. https://www.semanticscholar.org/paper/AI-Based-Job-Recommedation-System-using-BERT-Panchasara-Gupta/ed4d32d6d4f4ba0fb5d973540ab629a176b1bdf2

[6] Jain, H., & Kakkar, M. (2019). Job Recommendation System based on Machine Learning and Data Mining Techniques using RESTful API and Android IDE. International Journal of Advanced Research in Science, Communication, and Technology, 4(7), 263.

[7] Poncio, F. (2023). Navigating techniques in job recommender systems on internship profile matching: a systematic review. https://www.semanticscholar.org/paper/Navigating-techniques-in-job-recommender-systems-Poncio/f33fdf328c5c7589d36f7ae3f170b51d949a7851

[8] "Scrum: A Lightweight Software Development Framework."

[9] KVKK. "Personal Data Protection Law." KVKK

[10] GDPR and KVKK compliance guidelines: Ensuring user data security and privacy.

[11] Official documentation for React.js and Material-UI: https://reactjs.org and https://mui.com.

[12] PostgreSQL Database Documentation: https://www.postgresql.org/docs.

[13]   TensorFlow   and   Scikit-learn   Libraries   for   AI
implementation: https://www.tensorflow.org and https://scikit-learn.org.

[14]   Jenkins   and   GitHub   Actions   for   CI/CD
processes: https://www.jenkins.io and https://github.com/features/actions.

[15] ElasticSearch Documentation for search functionality: https://www.elastic.co/guide.

[16]   Prometheus   and   Grafana   Documentation   for
monitoring: https://prometheus.io and https://grafana.com