Developing an AI-powered Talent Shortlisting Application

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Abstract

The project explores the development of an AI-powered talent shortlisting application aimed at automating and optimizing recruitment processes. By implementing advanced large language models, specifically Llama 3.3-70B accessed via the Groq API, the application addresses inefficiencies that were present in traditional candidate screening, such as bias and resource-intensive manual evaluation. This application extracts key qualifications from job descriptions and matches them against anonymized resumes and finally ranks candidates based on relevance and suitability of a particular job role. The methodology involves a modular approach using Streamlit for the interface and a diverse dataset of resumes to evaluate system performance. The findings highlighted the application's capability to improve efficiency, fairness, and decision accuracy in recruitment. However, challenges such as computational resource requirements, the need for further fine-tuning and the integration of bias detection mechanisms remain areas for future development. The study concludes by emphasizing the potentiality of AI in recruitment, enabling the organizations to reduce costs and strategize on resource allocation effectively and efficiently.

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1. Introduction

In today's competitive and dynamic business world, the most crucial and valuable asset for the organization is Human. Due to new technologies, asset investment, money flow, and customer preferences along with other internal and external factors. Human Resource Management or HRM is key in getting the right applicant and shaping the organization's personnel. However, staffing, especially resume assessing, remnants prone to involuntary biases, indicating to unreasonable candidate assessments. These biases, often rooted in factors like gender, ethnicity, or socioeconomic background, reduce diversity and have significant financial implications. Research highlights that poor hiring decisions driven by bias can cost organizations between $15,000 and $50,000 per hire, and legal costs related to bias claims may exceed $300,000 per case (Madelin, 2015). Additionally, companies with diverse management teams report 19% higher innovation income, underscoring the tangible value of inclusivity in recruitment practices.

Traditional hiring methods struggle to keep pace with today's dynamic job market, where roles and required skills evolve rapidly. In the past, research has been conducted to address these challenges, integrating Machine Learning (ML) and Natural Language Processing (NLP) into recruitment processes. Transformer models, such as, BERT, SBERT, NER, etc. have contributed greatly to automating resume screening, reducing human bias and enhancing the evaluation process. However, with the advancement of Large Language models (LLM), it seems highly appropriate and efficient approach to implement LLM into the candidate profile screening process. Research indicates that leveraging AI in recruitment processes can bottom up to a 30-50% increase in operational efficiency and substantial cost depletions, making it a transformative solution for modern talent acquisition (*Artificial Intelligence in the Workplace, SHRM,* 2024).

Therefore, this project focuses on building an AI application that can help the recruiters to find the best candidates available in the market, reducing the time and resources significantly. The pitfalls of traditional candidate screening practices can be addressed using LLM, making recruitment decision in a more practical, adaptive and efficient way for the modern job market.

2. Problem Definition

In a world where recruitment is becoming more complex, companies face challenges in matching job requirements with the right candidates as well as meeting future skills needs. (Stone, Deadrick, Lukaszewski, & Johnson, 2015) The traditional approach often involves manual screening of CVs and a subjective valuation of employee potential. This is not only time and resource consuming, but it also increases the risk of hiring mistakes and an uneven process that can be imprinted by bias. (Glider, u.d.)

Furthermore, many companies face a competitive labour market where the demand for specific skills exceeds the supply. This creates complications in terms of finding the right candidates, which often results in ineffective hiring, high costs and a negative impact on the company's growth and productivity. (Sinkjær-Rasmussen, 2024)

An ineffective recruitment process can also have a direct impact on the employee satisfaction and a retention, as a mismatch between the job requirements and qualifications often leads to lower engagement and faster job turnover. According to a research study 25% of new hires leave their position within the first year. (Knudsen, 2024)

What if companies could use an AI-based solution, that saves time and resources by automating the review process while identify the best qualified candidates based on objective data? A solution like that, not only makes the recruitment process more effective, but also reduce bias and ensure a more fait and transparent valuation of the candidates' potential. By using advanced AI-tools like natural language processing and machine learning, companies can automate and optimize the recruitment process, which saves time and resources and ensure a more accurate match between candidates and job requirements. (Glider, u.d.)

Based on the problem definition, the projects research questions are formulated as follows:

2.1 Research Questions

1. How can an AI-based solution automate and optimate the recruitment process?

2. Which reasons drive companies to adopt AI-based solutions for recruitment?

3. Literature Review

To explore how AI-based tool can automate and optimise recruitment process while also identifying the reasons why companies chose to implement these tools, it is important to review literature and existing research in this field. This section examines central theories, methods and case studies that highlight the potential for AI in recruitment.

First, we will look at how AI technologies like natural language processing (NLP) and machine learning are being applied to automate various tasks in the recruitment process. This includes reviewing research that demonstrates how AI can analyse CVs, match candidates with job descriptions and significantly reduce time and effort required for recruitment.

Next, we will explore why companies choose AI in their recruitment process. Key reasons include saving time and resources, reducing human mistakes and making the process fair with using objective data. We will also investigate the challenges that organizations face regarding ethical questions and technical problems with AI.

Finally, we will collect the results of the reviewed literature to gain insights into how this research contributes to our research question.

3.1 Human Resource Management and Conventional Approach

Human Resource Management (HRM) aims on developing and executing policies, techniques, procedures and methods that shape and manage an organization's workforce (P.G, 2009). Recruitment is not the only function of Human resource management. It also focuses on KPI management, training and development, performance appraisal, compensation & Benefits management, talent management, conflict management succession planning, and many more. Traditionally, HR practices can be broadly divided into two key domains: acquiring human capital and developing human capital. The interconnectedness of these HR practices ensures an integrated approach to managing human capital across the employee lifecycle (Malik, 2018).

Strategic allocation of human resources is vital for any organization. Beyond managing tangible and financial assets, HR planning emphasizes analysing the job market and forecasting future workforce demands. By evaluating industry trends and technological progress, HR practitioners

can anticipate talent needs and craft strategies to address them. This proactive approach reduces skill shortages by hiring new employees or retraining existing staff (Jackson & Schuler, 1990).

The selection process is integral to hiring the right talent that aligns with both job requirements and organizational culture. A well-structured selection approach ensures that chosen candidates possess the required skills, qualifications, and attributes for their roles. This process fosters team[i] cohesion, enhances productivity, and contributes to organizational success (Karim et al., 2021).

The initial stage of the selection process involves conducting a job analysis to identify the qualifications required for a position, including the necessary knowledge, skills, and abilities. This analysis serves as the foundation for developing detailed job descriptions and specifications. Based on the findings, decisions are made regarding the segment of the labour market to target for finding the most suitable applicants. Depending on the group, recruiters select appropriate recruitment methods, such as social media, job boards, or newspapers (Islam, 2014).

Once job specifications and descriptions are prepared, recruiters can create job advertisements, which are published on relevant platforms. The recruitment process progresses as candidates submits their applications. HR professionals are then responsible for screening resumes to identify the best-fit candidates. Following this, the results of the initial screening are communicated to the applicants. Those who appear during this stage are selected and invited to further interviews. (Holm, 2012).

However, since resume screening is typically performed by HR personnel, it is prone to biases, which can negatively affect applicants. Biases often arise from unconscious preferences for specific traits or characteristics, undermining the objectivity of the screening process. For example, educational bias, halo effect, horn effect, Gender bias etc. To mitigate these biases during resume screening, organizations can implement tools such as structured interviews, diverse interview panels, and blind resume screening (Derous & Ryan, 2019; Whysall, 2018). Here we tried to define the different biases that influence the recruitment process:

- Name bias- It refers to convictions grounded on an applicant's name that possibly will lead to racial or cultural bias (Davis & Muir, 2003).

- Educational bias- a partiality for aspirants from precisely respected institutions may eclipse the skills and qualifications an aspirant brings to the table, creating an educational bias (Davis & Muir, 2003).
- Affinity bias- prejudice toward entrants who have similar concentrations, leisure pursuits, or associations, even if these components are irrelevant to job performance (Kahneman, 2011).
- Halo effect- It is a cognitive bias in terms of psychological terms. It occurs when a positive trait or impression in one aspect or area of the CV or the candidate directs to a complete positive assessment, overriding probable flaws or irregularities (Rosenzweig, 2007).
- Horn effect- It happens when recruiters judge the candidates on a single negative impression in one side of an applicant's profile which influences a general negative perception about the candidate (Kahneman, 2011).
- Contrast effect- comparing candidates against each other rather than against the job requirements (Tversky & Kahneman,1974).
- Age bias- It refers to the prejudice or stereotyping of persons based on their age, frequently rising in unfair behaviour, refusal, or norm about their capabilities, partialities, or appeals. It can occur against both younger and older individuals, though it is most associated with ageism against older adults (Butler, 1969).
- Gender bias- Preferential treatments to some certain group of candidates or group of people depending on gender on the assessment process (Eagly & Carli 2007).

Through our application, we can remove or minimize the above biases as it will be operated by AI. HR personnel can only focus on the skills and job requirements.

The Jobs-to-Be-Done (JTBD) framework, developed by Anthony Ulwick, offers an approach to gain understanding of customer needs by diving into the jobs the customers aim to accomplish with the product and their desired outcomes. The framework categorizes six types of customer needs, core functionality, desired outcomes, related jobs, emotional and social jobs, consumption chain jobs and financial desired outcome. By using the JTBD framework organizations can capture the complexity of customer needs and work on their innovation efforts. (Ulwick 2017)

3.2 Innovation Management with AI Transforming Human Resource Practices

In the businesses world innovation is one of the most prominent and practical terms. Without innovation and modification, a business organization cannot survive for a long period. Blending Innovation into recruitment or HRM with AI will help any organization to make decisions more accurate and reliable which eradicate the probability of impulsive decision making. In recruitment process, innovative ideas and speedy decision making can Streamlit the hiring process, enhance the candidates experience on half of the organization. Organization can use predictive analytical tools to select the best candidates. On the other hand, AI has its own challenges which may interrupt the innovative approach for the organization. For example, ethical issues might be considered in AI based recruitment approaches (Briciu et al., 2024).

The integration of artificial intelligence (AI) has revolutionized traditional HR practices, enhancing efficiency across various functions, from recruitment to employee development. For instance, IBM uses AI in HR to identify high-quality candidates even before they apply (Guenole, n.d.). AI algorithms also help eliminate biases in the recruitment process by masking characteristics like gender, race, ethnicity, and age during the screening phase. Furthermore, AI supports intelligent compensation planning and facilitates continuous skill development, highlighting its critical role in shaping the future of HR and managing human capital effectively.

Innovation involves employing specific entrepreneurial tools and strategies to alter resources into value, driving wealth construction and economic growth (Drucker, 1985). Artificial Intelligence can help human to process big data and draw a simple conclusion. For instance, idea generation and idea development. AI can help human to think separate ways for a particular problem by distant learning and creative solution. (Haefner, Wincent, Parida, & Gassmann, 2021)

While AI tools can streamline recruitment processes, integrating Open Innovation principles can further enhance these advancements. Open Innovation, introduced by Henry Chesbrough, emphasizes that companies can improve their practices innovation by leveraging both external and internal knowledge to create value. Compared to traditional closed innovation, where ideas are confined within an organization, open innovation encourages a flow of knowledge. This way companies can access outside expertise, reduce own development costs, and develop faster. This can be achieved by companies through licensing agreements, partnering with startups, or

crowdsourcing ideas, as well as sharing knowledge with external partners. In the context of HR, open innovation leads to external tools and platforms powered by AI-solutions to increase efficiency and optimize candidate selection. (Chesbrough & Appleyard, 2007)

3.3 Integrating Data Science: Machine Learning (ML) and Artificial Intelligence (AI) in Recruitment Process

Integrating or merging Data Science along with Machine Learning (ML), and Artificial Intelligence (AI) into Human Resource Management (HRM) can renovate conventional HR methods into further data-driven and competent systems (Alaghbari, Ateeq, Ali, Milhem, Beshr, Baligh, 2024) From the very beginning of science, Technology has always carried an indefinite influence within and in the recruitment process like reducing the cost per hire and ensured the effectiveness and efficiency in recruiting and selecting candidates (Okolie, 2017, Singh, 2003). In the context of Human Resource Management (HRM), data science combines insights from computer science, statistics, and behavioural sciences to extract valuable knowledge from various data sources, whether related to individuals, businesses, or other entities (Touvron, et al., 2023).

This study specifically focuses on shortlisting best candidates for a job by running a screening process using LLM. Therefore, we have chosen to use Llama, an advanced language model developed by Meta. Llama offers powerful possibilities for natural language processing (Touvron, et al., 2023). With the given knowledge of Llama's capacity to understand context and semantics in texts, it can be argued that the model can be used to analyse complex job applications, CVs, and optimise the recruitment process by creating a better match between candidates and job roles.

Research supports how AI can contribute to making recruitment more effective. According to Zimmermann, Kotschenreuther and Schmidt, these technologies enable automated processing of large amounts of data from CVs and job descriptions, reducing the manual workload of recruiters. Furthermore, AI can reduce the risk of subjective bias in the evaluation process as the analyses is being based on objective data rather than human evaluations. (Zimmermann, Kotschenreuther, & Schmidt, 2016)

Meanwhile earlier models like BERT and GPT-4 has been highly used in recruiting systems because of their ability to understand and process natural language, Llama gives the opportunity

to work with higher volume of text data and achieves competitive results with a smaller model size and training time. (Touvron, et al., 2023)

AI is getting more expanded in HR, and the market is filled with AI-solutions that can help the companies automate their recruitment process. According to a McKinsey-study, is AI in business increased with 25% annually and is expected to increase even further. AI is the future and will only have a huge impact in the recruitment process. Automating the recruitment process will save money and time and furthermore give the HR-apartment focusing on other tasks. (Dixit, Sharma, Maurya, & Dharwal, 2022)

Adopting AI in the recruiting process has a lot of benefits. AI supports every feature of recruitment and the whole hiring process in a lot of ways. AI supports a higher quality in the recruitment process precisely matching between the job application and the candidates. This contributes to a more positive experience for both the candidate and the employer since the company is getting the right candidate for interview. It also reduces the risk that the candidate is quitting either in the recruitment process or shortly after the employment. (Dixit, Sharma, Maurya, & Dharwal, 2022)

In a case study about how AI-tools are improving the recruitment process, Hilton Hotels have made a huge impact using AI-recruitment tools like HireVue and chatbots. These tools have made a remarkable reduction on the average time-to-hire from 6 weeks to 5 days, which gives a reduction on 85% in recruitment time. The company Unilever has also made a significant reduction on the average time-to-hire on 75% with using AI-recruitment tools like HireVue and Pymetrics. (Biradar, et al., 2024)

One of the most important benefits of using AI in the recruitment process is the significant reduction in cost per hire. Since time is money, AI can reduce the time taken from filling in a few open job positions to perform major hiring. Furthermore, AI is reducing valuable working time and resource costs. It has been reported that bigger companies have been able to make a reduction in the cost per hire by almost 30% using AI. (Dixit, Sharma, Maurya, & Dharwal, 2022) The company IBM that uses AI-tools in their recruitment process, has reported that the company made a big decrease in the recruitment costs with 30%. (Biradar, et al., 2024)

AI has shown how effective it can be to reduce hiring mistakes with analysing data like career history and test results. The analysis is giving a better groundwork to evaluate on how a candidate is fitting a specific job role. (TechFunnel, 2024) In this case, IBM has with help with Watson Recruitment reduced the hiring mistakes with 25% with precisely matching candidates with job roles based on their qualifications and earlier presentations. (Biradar, et al., 2024)

4. Innovation Management

Innovation management is crucial for developing an application that meets the needs of the recruitment field. It involves strategically integrating new technologies while adapting to user feedback and market trends. By adopting the frameworks open innovation and Jobs to Be Done (JTBD) the development process ensures that the app addresses real-world challenges faced by recruiters. Through this approach we can create a tool with a value proposition, long-term relevance and scalability.

4.1 Open innovation

To improve functionality and accessibility of the platform, collaborations with the most used HR platforms such as Workday and Greenhouse need to be pursued. By analysing their data output and workflows an API could be developed to integrate our shortlisting tool within these platforms. By integration, the user can access the tool directly within the HR tool. Furthermore, partnerships with industry-specific recruitment agencies could facilitate the creation of tailored solutions, addressing the unique needs of certain sectors. Additionally, incorporating user feedback is a critical strategy for continuous improvement and innovation. Building a feedback loop will provide valuable insights into output quality, user requirements and preferences, which could guide future enhancements. Finally, the app leverages the latest LLM releases with the highest level of contextual understanding and matching for our use case. By continuously adapting to improvements in the AI-field we ensure a state-of-the-art solution for our users.

Open innovation can enhance our application's development by enabling collaborations with HR platforms and recruitment agencies (external contributors), leveraging state-of-the-art LLMs

(external knowledge), and incorporating user feedback and developer contributions through APIs (coupled innovation), fostering continuous improvement and ensuring the tool remains cutting-edge and user focused. (Chesbrough & Appleyard, 2007)

4.2 Jobs to be Done

The main job to be done for the shortlisting application is to "help recruiters quickly and accurately identify the best candidates for a role." This objective reflects the functional, emotional, and social dimensions of the user's needs.

Functional Dimension: Recruiters require precise and reliable candidate rankings to streamline their decision-making process and start the hiring process efficiently. The tool must deliver consistent accuracy in matching candidate qualifications with job requirements.

Emotional Dimension: The tool addresses recruiters' frustration with time-consuming and error-prone manual evaluation by offering a faster, data-driven solution. Moreover, it ensures confidence that no top talent is overlooked, reducing the probability of potentially missing high-value candidates.

Social Dimension: Modern organizations prioritize fairness, inclusivity and alignment with their corporate values during the hiring process. By embedding fairness and transparency, the tool enhances the recruiter's credibility and aligns hiring practices with organizational commitments to diversity and equity.

To support these dimensions, the app should incorporate features like customizable scoring metrics and transparent AI explanations. These features not only ensure functional precision but also build trust and foster user confidence in the tool's fairness and decision-making. Additionally, providing recruiters with clear, interpretable results aligns with social objectives, promoting accountability and inclusivity in hiring practices.

We further identified the following pain points and gain points

Pain points	**Gain points**
Time consuming processes: Manually filtering hundreds of resumes	Faster and automated shortlisting
Bias concerns: Fear of unintentionally favouring certain candidates	Enhanced fairness through anonymized resumes
Lack of transparency: Difficulty explaining why candidates were shortlisted or rejected	AI offers explanation of candidate ranking
	Better communication with hiring teams using visual or report-based insights

We also translated the JTBD dimensions into the necessary practical features for the user.

JTBD Dimension	**Feature Example**
Functional	- **AI Matching Algorithm**: Matches resumes to job descriptions based on skills, experience, and relevance.
Emotional	- **Keyword Gap Analysis**: Shows where candidates meet or fall short of job requirements.
Social	- **Collaboration Tools**: Allow hiring teams to review and comment on candidate rankings.

For the supporting jobs, the app can be enhanced to also support recruiters with onboarding and pipeline management. As all the candidates' qualifications are analysed, the HR teams can quickly align new hires with the correct training programs, teams and roles ensuring a smooth transition into the organization as well as map out future career trajectories.

To align the application to the user needs, different testing methods can be employed. Usability testing will be conducted to observe how users interact with the tool, further identifying pain points. The feedback loop regarding the LLM outcomes will help understand contextual problems

in need of solving. As the application evolves and new features are added, feature usage analysis will become increasingly valuable in understanding how users interact with these new functionalities. By monitoring which features are most frequently utilized, we can assess their effectiveness in addressing user needs and identify areas for further improvement. (Ulwick 2017)

5. Methodology

The following methodology was designed to develop a solution for shortlisting job candidates with the help of an LLM thus improving efficiency in companies. The goal of our application is to analyse job descriptions on their key information for any given role. Key information can be in the form of needed educational background, years of experience and field of work for a role. Those insights paired with a list of applicants for the respective position is then evaluated by an AI–Model with the goal listing the top candidates for the role. The app will be based on the LLM Llama 3.3-70B, accessed through the Groq API. For the Interface we chose Streamlit.

5.1 Data Description:

The application is designed to assist companies with recruitment across various positions. To analyse job descriptions, we selected a diverse set of examples from different industries, roles, and countries. These job descriptions will be processed by the language model as plain text, making it simple to extract and input data from job boards.

For the resume dataset, we opted for a more carefully curated approach. We used a collection of 2,483 anonymized resumes from 25 different job categories, sourced from the user TalanAI on Huggingface. (TalanAI, 2023)

This dataset has profiles with similar experience in the same field, as well as profiles from different industries. This diversity facilitates the testing of different job descriptions while simultaneously enabling the evaluation of the quality of the outcome of the ranked applicants. Given that the dataset has already been anonymized, no further measures are required to ensure compliance with

privacy regulations. Additionally, we can be confident that the AI model does not unintentionally discriminate against individuals based on personal characteristics.

5.2 Model Selection:

For this project we utilize Llama 3.3-70B (released 06/12/2024), the latest version of the Llama LLM series as of 15/12/2024. This model just like other Llama variants are available through an open-source licence, allowing for easy deployment and use. An improvement over the previous version 3.2. 1B is the higher contextual understanding without the need of fine-tuning.

Llama 3.3 utilizes a transformer-based architecture with 70 billion parameters, allowing the model to identify patterns and relationships within the input to generate contextual outputs. A distinctive feature of 3.3 is the implementation of Grouped-Query Attention (GQA), reducing the computational requirements and enabling faster processing, making it comparable to larger models like 3.1 405B while requiring less hardware. (Meta, 2024)

The trade-off of using such a large model is its higher computational resource demand. However, by leveraging the Groq API, we can outsource the heavy computational load. For our use case Llama can handle job descriptions and resumes without the need to fine-tune the outcome. Llama's output is structured as a generalized Query Answering, which allows for matching of any job description to specific resumes. The query-answering mechanism can then rank or score resumes based on their relevance to the job description. The output can be either as plain text or in the JSON, facilitating the construction of a pipeline connecting multiple operations performed by LLMs. The model 3.3 70B further offers support for eight languages useful for global deployment. Because the model has been trained on 1.5 trillion tokens it can identify industry specific keywords through its state-of-the-art architecture. As it is a bigger LLM it requires high computational power, which is a challenge for this project. An opportunity is using 3.3 through an API similar to Together.ai, outsourcing the computation to an open-source solution. One of those providers is Groq, allowing access to 3.3 70b through their API. (Kodexo Labs, 2024)

Initially, we experimented with the 3.2 1B model for our application, as it appeared suitable for the task. However, to optimize its performance, fine-tuning was required. This process proved to

be particularly challenging due to the lack of labelled data, as well as issues with output quality and consistency across different job fields.

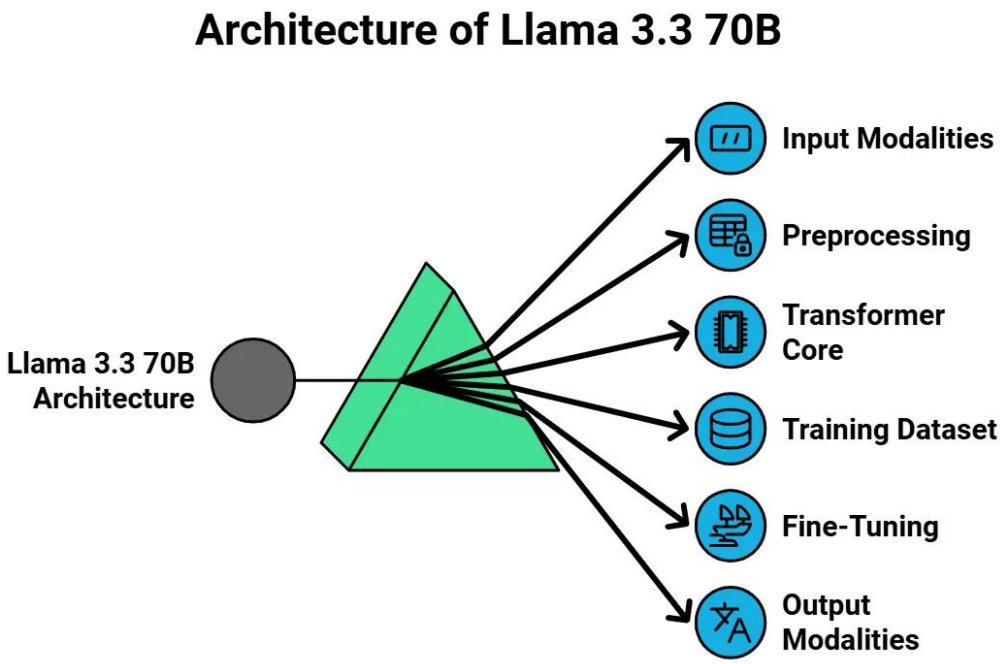

Figure 1: Key characteristics of the Llama 3.3 architecture

4.3 Modular breakdown of the Application

The app uses two primary inputs: a job description pasted into a designated field and a CSV file containing the list of resumes from the job applicants. The job description is pasted into a designated field and saved in the "job.txt" file. If the field is empty, the system immediately notifies the user. The "job.txt" file is then read in the JobDescription.py script. Here a structure template with the job title, company, location, key responsibilities, required skills and preferred Qualifications is used for the structure of the output of the LLM. An API call to Groq is used to access an external server to run the LLM. The prompt specifies the role as an HR assistant in charge of analysing the job description based on the structure template. As the output must follow the actual input closely, the temperature is set to a value below 1, reducing randomness in decision making by the LLM. The output is then parsed to a JSON file. On the website, users can view the results along with a prompt inviting them to provide further clarification or specify any differences in the candidate requirements.

In the next step the user must upload the CSV file containing the resume data of the applicants. If the user uploads non-CSV files, the program bestFit.py returns an error. The script then loads the previous analysed JSON. The prompt specifies the role as an HR assistant who must find the best 5 candidates for the analysed job description with reasoning for each candidate. The temperature again is set to a value below 1. The output is saved in a JSON file as well as output for the User to see in the Streamlit app. A new csv with the ranked candidates and the reasoning can then be downloaded.

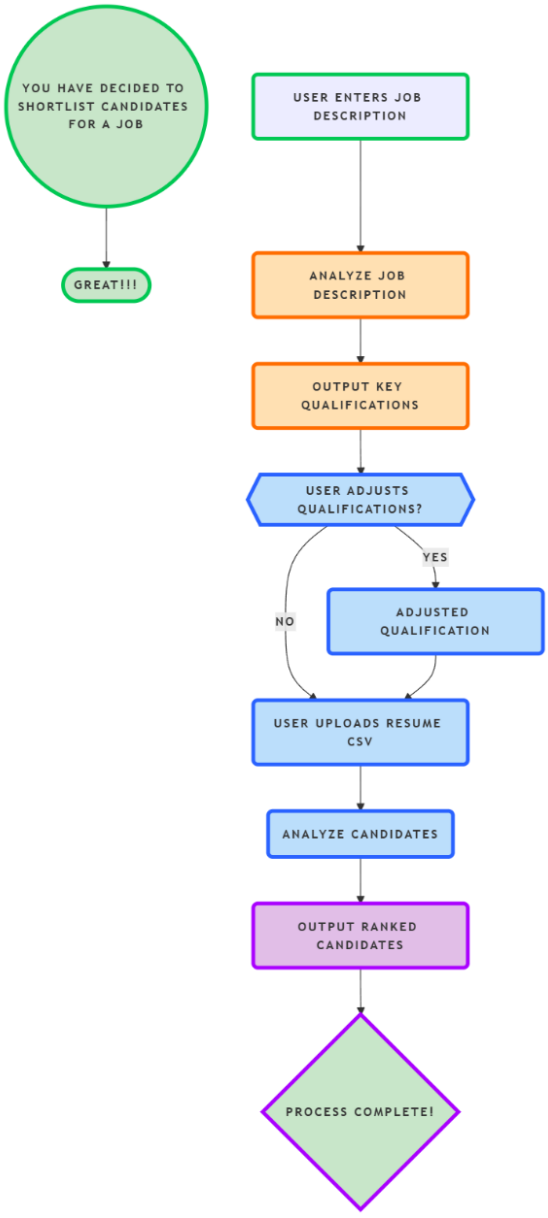

Figure 2: Flowchart of the shortlisting application

5.4 Evaluation Methodology

To assess the effectiveness of the application a manual evaluation approach is used, focusing on accuracy of job description analysis and the relevance of shortlisted candidates. The evaluation involves analysing 10 real-world job postings across various roles with the use of the resume dataset to rank the most suitable candidates. The goal of the assessment is to validate whether the shortlisted candidates possess the necessary qualifications to fill the job requirements. The output will be reviewed for logical consistency and alignment with the specified job criteria.

For a better grading of the applications output the use of hard labelled data would have provided a reliable benchmark of the system. Hard labelled data, such as predefined candidate rankings, would allow for an objective assessment of the system's accuracy. For the real-world application personnel in charge of hiring can give Feedback regarding the output quality.

5.5 Ethical and practical considerations

This project aims to use AI-models in a manner that actively avoids discrimination based on factors such as gender, race or other personal characteristics. As job descriptions are inherently written to be non-discriminatory and the dataset was anonymized, we mitigated any discriminatory patterns by the AI. However, we are aware that when working with non-anonymized data, hidden patterns of bias may appear, which must be dealt with. The handling of non-anonymized data needs to be further investigated. This includes techniques like data balancing, bias checks and frequent testing of model results to ensure they align with fairness objectives.

5.6 Visualization

The interface of the application is focused on user-friendliness with clear, intuitive visualizations to enhance the recruitment process. Streamlit offers recruiters easy access to the LLMs with a straightforward overview of the most suitable candidates. Below is a screenshot of the minimum viable product (MVP) of the Streamlit interface. The app can be accessed at https://huggingface.co/spaces/SamilD/Semester_1_Final_Project

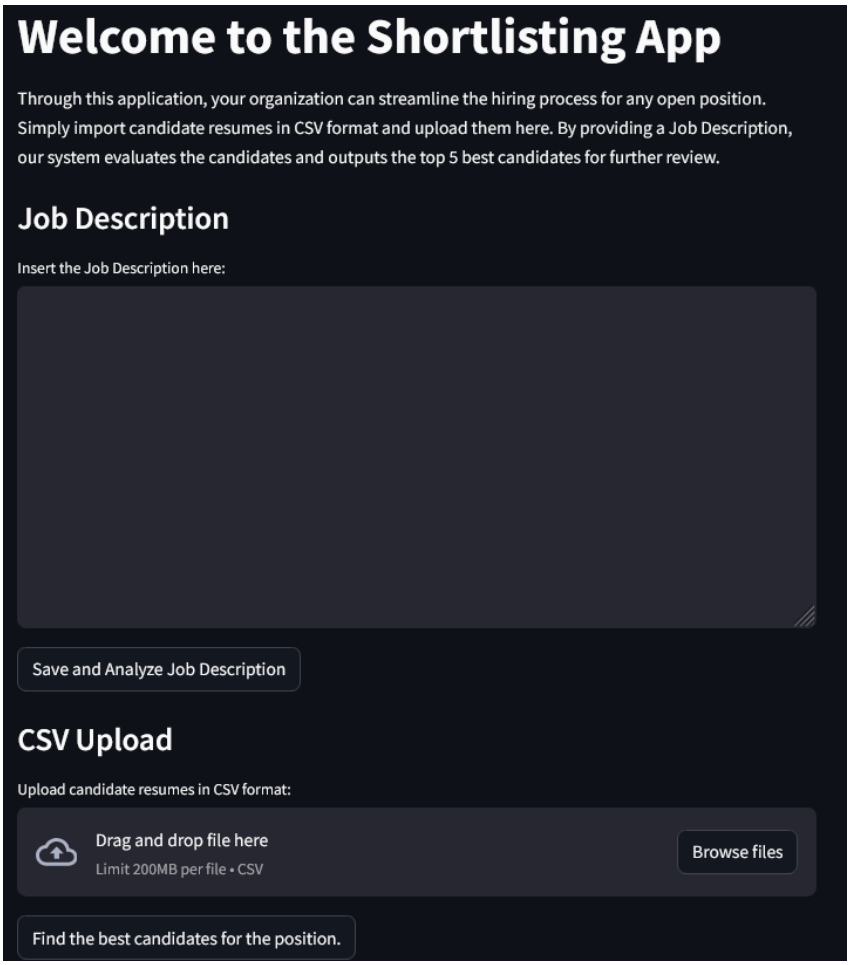

Figure 3: Streamlit Application

6. Research findings

This project's research questions regarded the automation and optimization in the recruitment process through AI-based solutions and the factors contributing to the change towards AI-based solutions. Regarding the first question, our findings demonstrate that the app can automate the screening portion of the hiring process, extracting industry specific information in job descriptions and then using these in a dataset to rank resumes outputting the best candidates. From this step HR and the hiring manager can pick up the data and move further along the hiring process. As for the

second question, companies can utilise AI-based solution because they can save time and resources by automating repetitive tasks like screening application data. In addition, the app promotes objective decision-making by analysing and ranking applicants based on predefined criteria, ensuring that the best-qualified candidates are identified efficiently.

Based on the research question how AI-based solutions automate and optimize the recruitment process our application has shown to streamline the initial screening process of any hireable position. By providing the job description the LLM was able to successfully identify key qualifications and subsequently select the candidates in the Dataset with the required skills. The reasoning behind the selection is understandable and based on facts. Our findings suggest that the app effectively automates screening for positions requiring standard qualifications. However, further testing is needed to assess its performance on highly specialized roles or datasets with greater complexity.

Our application automates the first step of the recruitment process by shortlisting the valuable candidates and rejecting the unsuitable ones. This streamlines the workflow, saving time and resources for hiring teams. However, the current solution still requires the involvement of the hiring manager beyond these stages as well as to validate the outcomes manually. While full automation is not yet achievable, our product offers a foundation to build upon in the future. The current version operates as a standalone tool. Future iterations will focus on seamless integration with existing ATS platforms to streamline workflows further.


```
{
    "jobTitle": "HR Generalist & Office Manager",
    "company": "Files.com",
    "location": "Scottsdale, AZ (Old Town)",
    "keyResponsibilities": [
      "Lead onboarding and offboarding processes",
      "Administer employee benefits",
      "Coordinate company travel",
      "Manage office operations",
      "Plan and execute in-office events"
    ],
    "requiredSkills": [
      "Strong organizational and multitasking skills",
      "Excellent interpersonal and communication skills",
      "A proactive, self-starting attitude and problem-solving mindset"
```

```
    ],
    "preferredQualifications": [
      "Minimum of 1 year of HR experience",
      "Minimum of 1 year of Office Management experience",
      "Ability to lift up to 25 lbs"
    ]
  }
```


Figure 3: Job description analysis JSON Output


```
{
    "analysis_result": {
      "topCandidates": [
        {
          "rank": 1,
          "email": "21190805@gmail.com",
          "experience": "PROGRAM DIRECTOR / OFFICE MANAGER",
          "reasoning": "The candidate has experience as an Office Manager, which is a key requirement for the HR Generalist & Office Manager position. They also have a strong background in management, which could be beneficial in leading onboarding and offboarding processes."
        },
        {
          "rank": 2,
          "email": "17812897@gmail.com",
          "experience": "HR MANAGER",
          "reasoning": "The candidate has experience as an HR Manager, which aligns with the key responsibilities of the HR Generalist & Office Manager position, including administering employee benefits and coordinating company travel."
        },
        {
          "rank": 3,
          "email": "22323967@gmail.com",
          "experience": "HR SPECIALIST, US HR OPERATIONS",
          "reasoning": "The candidate has experience in HR operations, which could be beneficial in managing office operations and planning in-office events. They also have a strong background in HR, which aligns with the key responsibilities of the position."
        },
        {
          "rank": 4,
          "email": "27018550@gmail.com",
          "experience": "HR SPECIALIST",
```

```
          "reasoning": "The candidate has experience as an HR Specialist, which
aligns with the key responsibilities of the HR Generalist & Office Manager position,
including leading onboarding and offboarding processes and administering employee
benefits."
        },
        {
          "rank": 5,
          "email": "16852973@gmail.com",
          "experience": "HR ADMINISTRATOR/MARKETING ASSOCIATE",
          "reasoning": "The candidate has experience in HR administration, which
could be beneficial in managing office operations and coordinating company travel.
They also have a strong background in administration, which aligns with the key
responsibilities of the position."
        }
      ]
    }
  }
```


Figure 4: Best candidate output in JSON format

7. Discussion

This section reflects on the findings encountered throughout the project. The application signifies potentiality in transforming traditional recruitment process into an automated and optimized process. For the resume screening and shortlisting task, Llama 3.3-70b was able to successfully identify the key qualifications of the candidates and rank them based on the job description. This approach could save large number of time and organisational resources during the recruitment process, addressing the critical pain points. Furthermore, the application provides the flexibility to the HR professional or hiring managers to find their preferred candidate based on their specific requirement and context.

In response to the first research question—*How can an AI-based solution automate and optimize the recruitment process?* — the application proves to be effective for automating the initial stages of the screening process. It could extract the required key qualifications from job descriptions and evaluate resumes against these criteria. By ranking and shortlisting the candidates, the application

reduces the time and resources required for manual screening. If this screening task would have been done by a human recruiter, it could take days to screen them. Furthermore, the application improves the accuracy of finding the right candidate for the right job role in a more consistent manner, reducing unconscious biased human judgement. The modular design ensures that the application adapt to the recruiter's specific requirement for screening.

In response to the second research question—*Which reasons drive companies to adopt AI-based solutions for recruitment?* — Companies usually adopt AI-based solutions to save time, reduce operational cost and improve the quality of decision-making. Using this AI application for repetitive task like resume screening, companies now can focus on allocating resources to impactful strategic HR functions, improving the organizational and employee development. Furthermore, the tool shows fairness and transparency, reducing the unconscious biases and ensures candidates are shortlists solely based on their qualifications.

A key perspective of this project is adopting an open innovation approach to ensure the application's relevance and scalability. This approach enables smooth integration and accessibility for recruiters in platform like Workday and Greenhouse. Partnering with industry specific recruitment agencies could further enhance the application's functionality by tuning it to unique industrial needs. Additionally, to remain valid and up to date with the industrial needs for recruitment, incorporating user feedback and developer contributions for continuous improvement is necessary.

Another framework, The Jobs to Be Done (JTBD) aligns with the application's features with functional, emotional and social dimensions of the user needs. Functionally, the application seamlessly delivers reliable candidate rankings, increasing efficiency of the workflow of recruiters. Emotionally, the frustration with repetitive tasks and overlooking talents is reduced by the application. Socially, the application enables organizations to recruit candidates with fairness and transparency, aligning with organizational value and culture. These dimensions have been addressed by the application, enhancing both the user experience and the organization's hiring outcomes.

However, despite its ability to automate the initial screening process, the application is not yet fully automated. Currently it needs HR personnel to validate the model's screening results to

ensure the quality and relevance of the shortlisted candidates. This keeps a possibility of getting biased selection on the selected candidates. To further refine the application for addressing this issue, fine-tuning of the model on hard labelled dataset on resume and job description fit data is necessary. If this could be done, then the evaluation would be much transparent and unbiased.

The extensive implications of this study reflect the role of AI in steering innovation within HRM process. This integration of artificial intelligence and recruitment process refines the operational time and resources of an organization in an innovative way, enabling the organizations to reallocate resources towards strategic initiatives. The application's performance in screening the candidates sets the stepping stone to further develop the application for the later recruitment process. Implementation of the modern talent acquisition approach of this application not only benefits the organization but also the candidates in securing a job that they deserve, enhancing the work environment in the organization and reducing work conflicts.

8. Limitations

While the application successfully illustrated the potential of AI application in recruitment process, some limitations were observed during the study.

The Llama 3.3-70b model could have been fine-tuned if actual hard labelled dataset were found. This restricted the study's process of evaluating the performance of the model with actual labels and with other available LLM's. Therefore, the model's output is currently validated by human personnel. Additionally, this validation approach may still result into biased judgement of applicants by the recruiters. Consequently, it is limiting the application's ability to provide fully autonomous solution.

Another limitation of using the model is its requirement of resources to run, which could be limiting small organizations to get access to high performance infrastructure or cloud-based APIs.

On top of that, the application currently supports CSV formatted resumes for simplicity. However, this might not be the most appropriate format of input for many organizations, as most of the

applications are submitted in the form of PDF. An additional extension of parsing PDF to CSV or JSON is required to optimize the data input pipeline.

Addressing these limitations sets the opportunity to further refine the AI application and optimize the solution for recruiters. Resolving these obligations would result into a more sophisticated application for the recruitment process and practice.

9. Further Development

From the limitations encountered during the study, many further scopes of development and improvement were realized.

Organizations need to recruit many employees for different role simultaneously. Which requires the model to handle multiple job descriptions and screen large volume of candidates for different role simultaneously. Extending this feature of the application will allow large scale organizations to streamline the recruitment process efficiently.

Currently the application is built on the base model of Llama 3.3-70b, therefore it requires human validation for evaluating the model's output. Additionally, due to this limitation the application is being partially automated only. However, this can be refined by further fine tuning the model on actual hard labelled dataset, which would then allow us to train, test and evaluate the model's performance after finetuning as well as compare its performance with other LLM's. As a result, with the improved accuracy, the validation can then be integrated with the model, allowing it to be fully automated.

Furthermore, at this stage, the application is fed with anonymized resumes to reduce unconscious human biases. However, the possibility of producing biased result still lies in the process. Therefore, integrating bias detection mechanisms and mitigating them will allow the application to produce fair and transparent results, adapting equality across diverse demographic groups.

To improve the data handling pipeline, an extension could be introduced to parse resume PDF into JSON or CSV. This will further optimize input pipeline, eliminating the need for manually upload resumes in CSV format.

Finally, an application's market need and impact depend on its ability to continuously adapting and improving its user's requirements. For which, a feedback loop can be introduced to collect insights from recruiters, allowing the developers to iteratively improve the application's features and performance.

10. Conclusion

In conclusion, this project successfully illustrates the implementation of AI innovation for HRM, automating and optimizing the recruitment process using Llama 3.3-70b. The application analyses job description and resumes to shortlist candidates instantly, making it a more efficient way of screening resumes compared to manual screening. The primary focus of the study is to reduce the time and resources organizations spend on screening resumes, which will allow the organizations to reallocate the resources to focus more on strategic HR functions. Additionally, the application addressed critical pitfalls involved in traditional recruitment process like inefficiency and unconscious biasness during screening candidates. The finding of the study states how AI could allow organizations to adapt innovation within organizational operations by addressing the pain points of recruitment process. The application could reduce the screening process significantly, allowing the organizations to allocate its resources for strategic HR functions. If finetuned for industry specific needs, the application will significantly become impactful for organization's recruitment operation and resource allocation.

Even though the application successfully shortlists deserving candidates for a given job role, the scope for further development and improvement for optimum outcome still lies here. Further enhancement regarding handling data pipeline, multiple job descriptions, bias detectors and ability to identify industry specific needs with finetuning and implementing feedback loops will increase the application's feasibility and applicability.

This study lays a strong foundation for integration AI into recruitment processes, focusing specifically on candidate screening function to optimize talent acquisition. It has laid several further scopes for enhancing the application. Successful completion of meeting the enhancement will allow the application to be deployed into large scale organizations and revolutionize the recruitment process.

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11. Appendix

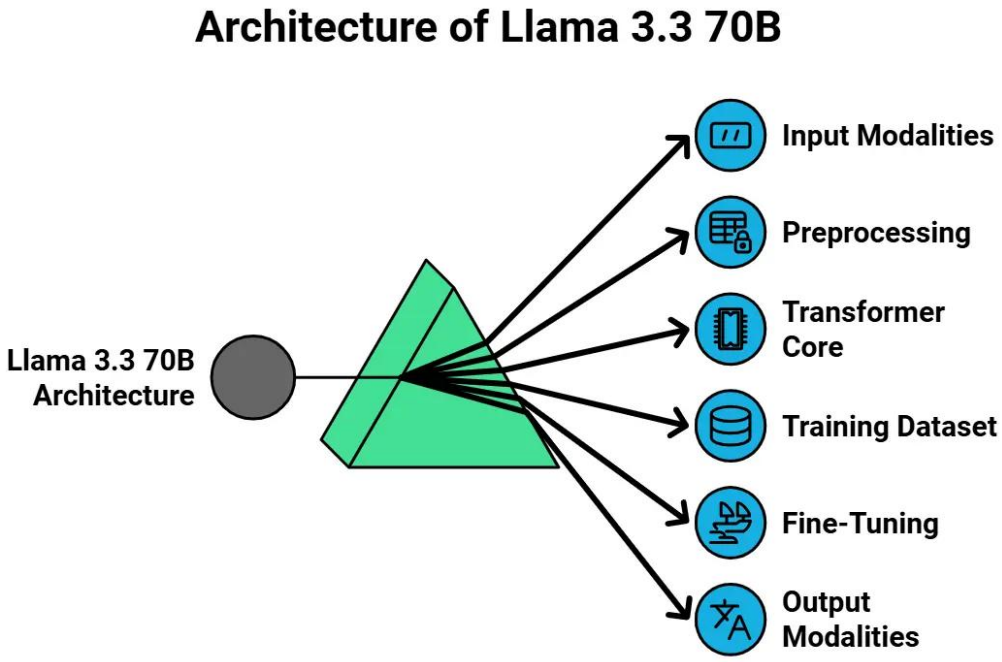

Figure 1: Architecture of Llama 3.3 70b, https://kodexolabs.com/meta-llama-3-3/

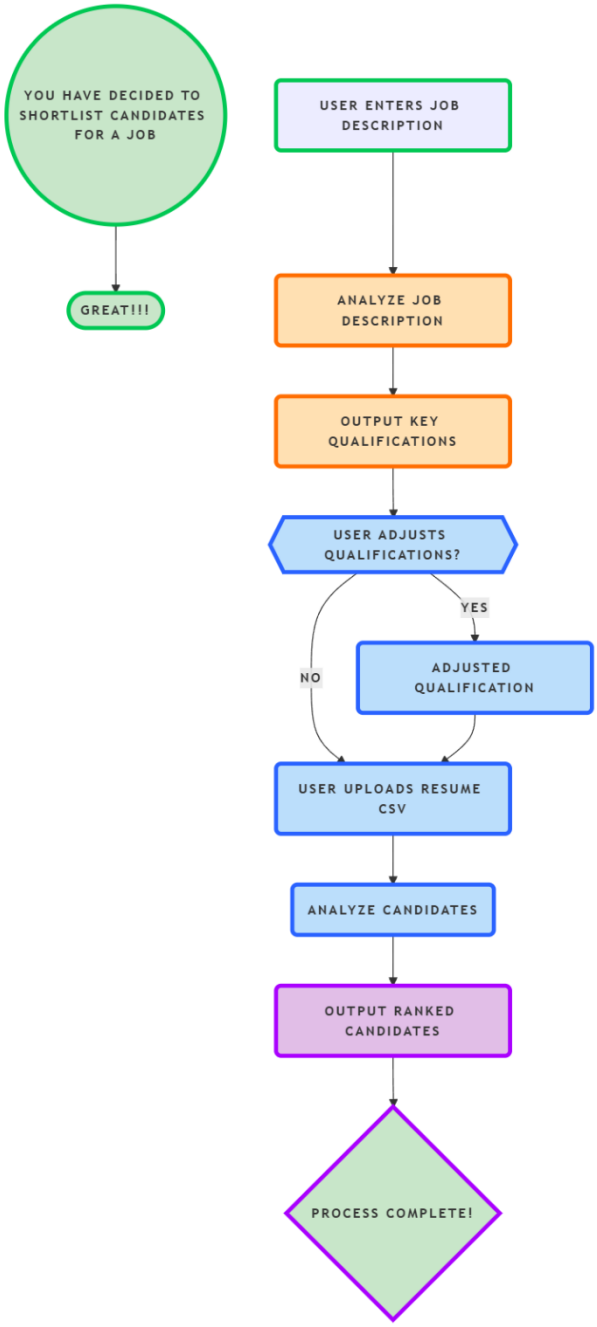

Figure 2: Flowchart of Shortlisting application

```
{
    "jobTitle": "HR Generalist & Office Manager",
    "company": "Files.com",
    "location": "Scottsdale, AZ (Old Town)",
    "keyResponsibilities": [
```

```
      "Lead onboarding and offboarding processes",
      "Administer employee benefits",
      "Coordinate company travel",
      "Manage office operations",
      "Plan and execute in-office events"
    ],
    "requiredSkills": [
      "Strong organizational and multitasking skills",
      "Excellent interpersonal and communication skills",
      "A proactive, self-starting attitude and problem-solving mindset"
    ],
    "preferredQualifications": [
      "Minimum of 1 year of HR experience",
      "Minimum of 1 year of Office Management experience",
      "Ability to lift up to 25 lbs"
    ]
  }
```


Figure 3: Job description analysis JSON Output


```
{
    "analysis_result": {
      "topCandidates": [
        {
          "rank": 1,
          "email": "21190805@gmail.com",
          "experience": "PROGRAM DIRECTOR / OFFICE MANAGER",
          "reasoning": "The candidate has experience as an Office Manager, which is a key requirement for the HR Generalist & Office Manager position. They also have a strong background in management, which could be beneficial in leading onboarding and offboarding processes."
        },
        {
          "rank": 2,
          "email": "17812897@gmail.com",
          "experience": "HR MANAGER",
          "reasoning": "The candidate has experience as an HR Manager, which aligns with the key responsibilities of the HR Generalist & Office Manager position, including administering employee benefits and coordinating company travel."
        },
        {
          "rank": 3,
          "email": "22323967@gmail.com",
```

```
          "experience": "HR SPECIALIST, US HR OPERATIONS",
          "reasoning": "The candidate has experience in HR operations, which could be beneficial in managing office operations and planning in-office events. They also have a strong background in HR, which aligns with the key responsibilities of the position."
        },
        {
          "rank": 4,
          "email": "27018550@gmail.com",
          "experience": "HR SPECIALIST",
          "reasoning": "The candidate has experience as an HR Specialist, which aligns with the key responsibilities of the HR Generalist & Office Manager position, including leading onboarding and offboarding processes and administering employee benefits."
        },
        {
          "rank": 5,
          "email": "16852973@gmail.com",
          "experience": "HR ADMINISTRATOR/MARKETING ASSOCIATE",
          "reasoning": "The candidate has experience in HR administration, which could be beneficial in managing office operations and coordinating company travel. They also have a strong background in administration, which aligns with the key responsibilities of the position."
        }
      ]
    }
  }
```


Figure 4: Best candidates JSON Output