



## AN EXPLAINABLE AI-POWERED CAREER RECOMMENDATION SYSTEM WITH SKILL GAP ANALYSIS AND INTELLIGENT ATS EVALUATION

### Machine Learning

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### ABSTRACT

With the complexity of internship and job selection processes, there is an increased need to develop intelligent and transparent recommendation systems. However, existing platforms often employ keyword-based filtering and black box approaches, which do not offer any significant insights to the end-users. In this context, this paper proposes an Explainable AI-based career recommendation system that leverages resume analysis, skill gap calculation, and Applicant Tracking System-based evaluation. The proposed system uses various Natural Language Processing approaches such as Named Entity Recognition and TF-IDF to derive structured features from resumes. Additionally, it employs a graph-based approach to calculate skill gaps and generate dependency-based learning paths. Similarly, internship recommendations are achieved using similarity-based ranking, while salary prediction is achieved using machine learning approaches. Explainability is achieved using SHAP-based feature attribution. Additionally, the proposed system is beneficial to recruiters as it offers an HR module that facilitates efficient evaluation of candidates using interpretable recommendation outputs. Experimental results reveal an F1-score of 87%, indicating the efficacy of the proposed system in bridging the gap between candidates' capabilities and industry needs.

### KEYWORDS

Resume Analysis, Explainable AI, NLP, Career Recommendation, Skill Gap Analysis, ATS

### INTRODUCTION

The rapid growth of digital job platforms has added complexity to the process of internship and job selection. The traditional approach to this problem uses keyword matching, which does not take into account semantic relationships between resumes and jobs [3]. This approach also does not provide any explanations for the recommendations [1].

The problem faced by students includes a lack of guidance on suitable opportunities, and for recruiters, the problem includes inefficiency in manual screening [7]. Moreover, the proposed system helps the recruiter efficiently evaluate the candidates and shortlist them based on the recommendations provided by the system. This helps the recruiter make efficient hiring decisions. Additionally, the proposed system filters the candidates using Applicant Tracking Systems (ATS), but this process does not provide any explanations [2]. To solve this problem, this work proposes an Explainable AI-based career recommendation system that includes resume parsing, skill gap analysis, learning path creation, and evaluation using ATS.

### Related Works

The current literature has focused on improving the accuracy and interpretability of recruitment systems. In this context, Tang et al. [1] have emphasized the need for transparency in recommendation systems. Lo et al. [2] have proposed the application of LLMs in resume screening. Sabarirajan et al. [3] have proposed the application of NLP and XAI in ranking candidates. Wang et al. [4] have proposed the application of explainable re-ranking. Zadykian et al. [5] have proposed the application of knowledge graphs in semantic matching. Schellingerhout [6] has proposed the application of knowledge graphs in multi-stakeholder interpretability. Karunamurthy et al. [7] have proposed the application of AI in resume recommendation systems. However, the current literature lacks the inclusion of skill gap analysis and learning paths in the recruitment systems. In addition, there is less focus on the inclusion of recruiter-focused modules in explainable AI.

### Proposed System

The system comprises several modules that are interconnected and facilitate intelligent recommendations.

The Resume Processing Module employs Natural Language Processing techniques like Named Entity Recognition and TF-IDF for text extraction. The Skill Gap Module identifies the skills of the applicant and the requirements of the role and then ranks the skill gap using graph-based centrality and proximity. The Learning Path Module is used to generate dependency-aware skill sets. The

Recommendation Engine uses similarity-based ranking for generating internship recommendations. The Salary Prediction Module uses machine learning techniques like Random Forest and Gradient Boosting. The Explainability AI Module uses SHAP for feature attribution. The ATS Module uses weighted scoring for resume-job compatibility. The HR Module helps the recruiter analyze the candidates and shortlists them efficiently.

The system also comprises the Retrieval-Augmented Generation Module, which helps in generating knowledge-grounded and context-aware explanations for the recruiter for the ATS-related queries.

### METHODOLOGY

The system follows a pipeline architecture wherein resumes are processed using NLP to obtain features. The skill gap analysis is performed based on the extracted and required skills. The unavailability of skills is ranked based on the following formula:  $Score(m) = Degree\ Centrality(m) + Proximity(m)$

Internship recommendation is based on TF-IDF similarity score, and salary prediction is based on regression models chosen based on minimum Mean Absolute Error (MAE). Feature attribution is performed based on SHAP and rule-based methods for explainability.

The RAG-based method is used for retrieving relevant information and generating context-aware responses for ATS education.

### RESULTS

The proposed system has been assessed using performance metrics. The proposed system's recommendation model has scored an F1-score of 87%. This has improved the performance of the proposed system in comparison with the conventional models using the keyword-based approach [3], as presented in Table 1.

The proposed models for the prediction of salaries have performed well. The models have been observed to be highly affected by factors like experience, skill count, and interactions. The proposed system has generated interpretable results like skill gaps, learning paths, and recommendations. This has improved the usability of the proposed system. The RAG module has improved the usability of the proposed system by incorporating the concept of explanations. The HR module has improved the process of shortlisting candidates by using the insights gained.

**Table – 1 Performance Metrics of Proposed System**

Metric	Value
F1-Score	87%
Accuracy	85%
Precision	88%
Recall	86%

**Discussion**

The proposed system improves the accuracy and understandability of the recommendation by using explainable AI, skill gap analysis, ATS evaluation, and RAG-based explanations. This will help in understanding and gaining clarity for both the candidate and the recruiter. In addition to this, the system will be useful for the candidate in understanding skill gaps and learning in a structured manner for career progression. The system will also be useful in efficient decision-making by providing understandable outputs.

**CONCLUSIONS**

In this paper, a novel Explainable AI-based career recommendation system, which incorporates resume analysis, skill gap detection, learning path generation, and ATS evaluation, was proposed.

The potential for the proposed system to be improved by the incorporation of real-time job, transformer, and multilingual capabilities was discussed, but its success relies on the quality of the skills and role data extracted.

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