

# Advancing Resume Screening with Transformer-Based Deep Learning and Graph Neural Networks

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**Abstract:** *Traditional resume screening systems, reliant on keyword matching (e.g., Jaccard/Cosine similarity), struggle with semantic understanding, multilingual content, and contextual evaluation, leading to biased and inefficient hiring processes. This paper introduces an AI-driven resume analysis system that integrates Transformer-based deep learning (BERT) and Graph Neural Networks (GNNs) to address these limitations. Leveraging multilingual BERT embeddings, the system interprets semantic context and synonyms (e.g., "machine learning"  $\approx$  "ML"), enabling accurate analysis of resumes in 10+ languages, including Spanish, French, and Chinese. The GNN component models structural relationships between resume sections (e.g., correlating "Education" with "Technical Skills") to holistically evaluate candidates beyond isolated keywords. A hybrid approach combining sentiment analysis and keyword detection identifies soft skills like leadership and teamwork, while Explainable AI (XAI) tools (LIME/SHAP) provide transparency by highlighting phrases influencing decisions (e.g., "optimized AWS costs by 30%" increased the cloud engineering score).*

*Tested on 500+ resumes and 200+ job descriptions, the system achieved 89% accuracy in resume-job matching, outperforming Jaccard similarity by 39% and BERT-only approaches by 14%. It processes resumes in 8.2 seconds on average using AWS GPU instances and reduces recruiter screening time by 40%. Key innovations include multilingual fairness (88% F1-score for non-English resumes) and bias mitigation through semantic analysis. The system's scalability and transparency.*

**Keywords:** Transformer Models, Graph Neural Networks, Multilingual NLP, Explainable AI, Semantic Resume Analysis

