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Assignment Report: Intelligent Job Recommendation System for Job Seekers
Using Machine learning.

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1. Abstract

The purpose of this project is to develop an intelligent job suggestion system on the basis of machine learning and natural language processing techniques. The goal is to assist job applicants with personalized and appropriate job suggestions based on their qualifications, experience, and resume information. The motivation for this project stems from the hassle individuals face while working with large and unfiltered job listings, resulting in wastage of time and opportunities lost. By applying content-based filtering techniques, resumes are matched with job descriptions on the basis of text similarity measures by the system, enabling better and precision-based job matching. The proposed approach is to pull out significant skills and experiences from job descriptions and resumes, present this information as numerical vectors, and compute similarity scores using cosine similarity. One of the key contributions of this project is the integration of different datasets, including Wuzzuf job postings, LinkedIn job postings, and categorized resume data, which provide a diverse and broad training base. This multi-source approach enhances the robustness of the model and allows broader generalization over diverse job fields. The desired outcome is a lightweight and explainable job recommendation system that can be extended later to include hybrid approaches and explainable AI components. The software tools used for this project include Python, Gensim, Scikit-learn, and NLP packages such as NLTK. The system is scalable and can be tailored to fit realistic job matching applications.

2. Introduction

In today's competitive labor market, it is difficult to get a suitable job due to the number of job postings and lack of personalized matching systems. A job recommendation system can ease this heavy load by preventing the necessity for manual matching via automation. The systems utilize AI and machine learning to process resume data and job postings. However, the issues are data inconsistency, unstructured text, and the cold-start problem. This report presents the motivation, methodology, and plan of action of a system that addresses these issues.

3. Problem Specification

The problem that this project aims to solve is the inefficiency and frustration that job seekers go through in trying to select the relevant job postings from thousands of job advertisements on the web. The absence of targeted filtering leads to lost matches and wasted time. This project proposes the development of a content-based job recommender system that automatically analyzes a user's resume and suggests the most appropriate job postings based on their interests, qualifications, and skills.

Formal Problem Statement:

Having a user's resume in textual format and a set of job postings (also in text), the problem is to rank and recommend a list of jobs that best fit the user's profile using machine learning and natural language processing techniques.

Scope and Boundaries:

- The system will have content-based filtering only in its first version, with focus on resume-job matching on the basis of skill and text similarity.
- No collaborative filtering methods, past application data, or user feedback will be utilized at this phase.
- Matching will only be based on textual characteristics of resumes and job descriptions.

Assumptions and Constraints:

- Resumes and job descriptions are English and semi-structured or structured.
- Users have at least one resume with extractable experience and skills.
- Job descriptions contain relevant features such as title, skills, and summary.

Type of Machine Learning Task:

This is a ranking problem, where the goal is to compute resume vectors and job posting vectors similarity scores, and suggest the top-N highest ranked jobs. It is not classifying or regressing in the classical sense, but involves unsupervised feature extraction and similarity matching.

4. Motivations

The challenge addressed in this project is of significant importance today in the job market, where candidates often struggle to recognize correct offers among thousands of postings. The lack of personalized filtering procedures leads to wasted time, frustration, and poor matching outcomes. A so-called intelligent recommendation system can significantly lighten this burden by offering suggestions of employment that are dependent on a person's skill, experience, and goals. In practical terms, the systems can be used on job websites, hiring programs, or professional development services to increase user satisfaction and improve placement

efficiency. At the school level, the project involves large areas of artificial intelligence such as NLP, recommendation systems, and vector similarity measures—therefore a great learning and research experience.

From a business perspective, even though job referral is prevalent in global platforms like LinkedIn or Indeed, there is still a lack of local, understandable, and lean solutions—especially in Middle East Arabic countries or emerging economies. This creates a valuable ground for innovation and applied research to bridge the gap.

At a personal level, inspiration for this project comes from a personal experience of facing challenge during a lengthy process of job search. It is this challenge that inspired the development of a system that can assist other people in facing.

5. Objectives

Primary Objective: Create a content-based job recommendation system for suggesting jobs to users based on resume analysis.

Secondary Objectives:

- Extract significant features from resumes and job postings through NLP.
- Utilize similarity measures (e.g., cosine similarity) for ranking job postings.
- Evaluate performance based on precision, recall, and F1-score.

Long-term Impact: The system can be extended as a hybrid recommender platform deployed in real recruitment tools.

6. Literature Review

In **paper [1]**, "A Deep Learning Approach to Job Recommendation with NLP", the authors proposed a content-based recommendation model based on Word2Vec for text representation of resume and job description, then ranking by cosine similarity. The model was trained on Stack Overflow developer survey and scraped job postings from the internet. Notwithstanding the system had a good F1-score of 0.59, precision broke down due to Word2Vec's unrelated skill expansions. Moreover, the model suffered from cold-start failures and lack of diversity.

In **paper [2]**, "Job Recommendation System Combining Collaborative and Content-Based Filtering", the authors experimented and compared a number of models including CBF, CF, and some hybrid setups. Experiments showed that combining basic CBF and improved CF with Word2Vec achieved the best performance (Recall = 63.97%). The paper also highlighted the importance of skill generalization (e.g., grouping frameworks under parent languages like PHP) to reduce dimensionality. However, despite strong recall,

the system's performance decreased when tested on users with limited application history. **Paper [3]**, "Job Recommendation System Using Content-Based Filtering and Word2Vec", focused on user profiling from the jobs they applied to earlier. In Word2Vec, user skill vectors were enriched by incorporating top-10 similar skills.

Although it was meant for more relevance, it resulted in lower accuracy (Recall = 30.03%) because semantic noise could be added. The study demonstrated that naive Word2Vec enrichment without context filtering can decrease the quality of recommendations, emphasizing coverage vs. accuracy trade-off.

Collectively, these papers inform our project approach. From [1] and [3], we know the pros and cons of using Word2Vec in content-based filtering. Paper [2] shows the benefit of hybrid models in improving recall. Thus, we begin with a content-based system due to its interpretability and simplicity of implementation, with potential future improvement through hybrid approaches and explainable AI.

7. Proposed Methodology

The project will be using a content-based recommendation system using Word2Vec for text vectorization.

The technical approach envisioned for this project is content-based filtering, which is based on analysis of the textual content of user resumes and job postings to determine similarity. The reason for this is its ease, interpretability, and usability on datasets with no user interaction history.

The system primarily uses cosine similarity, which is a metric that computes the angle between vector representations of resumes and job descriptions. We employ Word2Vec, a popular word embedding model, to map words to dense numerical vectors based on their semantic context, and utilize it to represent jobs and resumes in the same vector space. We used this strategy since it is effective and can yield semantic relationships between skills and job descriptions. It also has fairly fast computation and scalability, which is suitable for real-time recommendations.

The preprocessing pipeline consists of a number of steps:

- **Processing of text:** removing punctuation and case folding.
- **Tokenization:** splitting text into words.
- **Stopword** removal and lemmatization to reduce word forms.
- **Characterization** of skills from resumes and job posts.

Once the data is preprocessed, we train the Word2Vec model and generate embeddings. The system then calculates similarity scores between each resume and job posting, and recommends the top-N most similar jobs.

The project will make use of tools and libraries such as:

- **Python** for implementation.
- **Gensim** for Word2Vec modeling.
- **Scikit-learn** for similarity measures and evaluation.
- **NLTK** for text preprocessing.

8. Datasets Description

Four datasets will be used in this project:

1. **Wuzzuf Job Listings (2025):**
 - **Source:** Open-source dataset from Kaggle.
 - **Size & Format:** Over 8,000 job postings in CSV format from Egypt.
 - **Features:** Includes job title, required skills, company, location, and job summary.
 - **Preprocessing:** Removing duplicates, cleaning HTML tags, normalizing text.
 - **Challenges:** Some missing fields and repeated job titles.
2. **Resume Dataset – Gaurav Dutta:**
 - **Source:** Publicly available on Kaggle.
 - **Size & Format:** 893 text resumes categorized by job roles (PDF & TXT formats).
 - **Features:** Raw resume text with job domain labels (e.g., HR, Data Science, Developer).
 - **Preprocessing:** Converting to plain text, removing non-text elements, labeling.
 - **Challenges:** Limited resume count, some variation in formatting.
3. **LinkedIn Job Postings (2023–2024):**
 - **Source:** Open-source data collected via scraping (Kaggle).
 - **Size & Format:** 124,000 international job postings in CSV format.
 - **Features:** Job title, company name, location, detailed description.
 - **Preprocessing:** Standardizing titles, removing duplicates, cleaning text.
 - **Challenges:** Text inconsistency, some jobs missing skill fields.
4. **Resume Dataset – Snehaan Bhawal:**
 - **Source:** Open-source structured dataset from Kaggle.
 - **Size & Format:** Over 600 resumes in CSV format, labeled by profession.
 - **Features:** Resume text, labeled with job categories (e.g., Developer, Analyst, HR).
 - **Preprocessing:** Text normalization, tokenization, removal of stop words.
 - **Challenges:** Lack of detailed metadata (e.g., years of experience, location), but good structure.

9. Timeline of Second Semester Project (10 Weeks)

Week 1: Dataset collection and environment setup

Week 2: Data cleaning and preprocessing

Week 3: Feature extraction and vectorization

Week 4: Baseline recommendation system implementation

Week 5: Implement main model

Week 6: Fine-tune hyperparameters

Week 7: Evaluation and metrics collection

Week 8: Comparative analysis

Week 9: Write main report and prepare presentation

Week 10: Final review and submission

10. Expected Challenges

The following challenges are anticipated during the implementation of the job recommendation system:

- Extracting structured skills from free-text resumes is difficult due to variations in writing style.
- Using Word2Vec may introduce noise by expanding user profiles with unrelated skills.
- Cold-start problem for new users with limited historical data.
- Lack of real-time user feedback to validate recommendations dynamically.

11. Future Work

There are several areas where the system can be extended in future phases:

- Integrate collaborative filtering to enhance recommendation diversity.
- Incorporate explainable AI methods (e.g., SHAP, LIME) to justify recommendations.
- Build a web-based interface for real users and collect feedback for continuous model improvement.
- Add domain-specific filtering (e.g., for IT, Finance, Healthcare) for better personalization.

12.Reference

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ARSH KONERU AND 1 COLLABORATOR.

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