The Impact of AI on the CS Job Market Forecast Model

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Abstract

The rapid growth of artificial intelligence has led to an increasing number of questions about the effect on the computer science department. This project analyzes AI-related job postings to examine trends in employment within the computer science field. Using a simulated dataset of real-world AI job postings, we perform exploratory data analysis to evaluate the frequency of job postings over time and assess the effect on different computer science experience levels. The data is preprocessed by handling categorical and numerical features to ensure consistency for our model. Multiple machine learning models, including linear and non-linear approaches, were trained to classify job-related outcomes using standard classification metrics to compare the effectiveness across approaches. The results provide insight into how AI will influence employment patterns within the computer science job market. The dataset was examined to identify patterns in job roles, required skills, and experience distributions across AI-related positions. Visualization techniques were utilized to highlight trends to support comparisons between different positions in the job market. The classification models demonstrate certain job attributes, and experience levels play a significant role in distinguishing employment trends based on AI adoption. Overall, the findings suggest that the effects of AI on employment are not equal across all computer science roles and experience levels. This project provides a data-driven look at how AI is shaping the computer science job market.

1. Introduction

Artificial intelligence has changed from a niche research topic to a widely used tool across many industries, including technology, healthcare, finance, and manufacturing. This change has influenced hiring practices and job requirements worldwide. Many Organizations seek employees with AI related skills such as machine learning, natural language processing and data science. As noted by Nadeem et al., "growing influence of technological advancements and the complexity of business requirements have revolutionized the IT industry underscoring the critical need for a comprehensive understanding of the skills and tools most valued and prioritized by employers" [6]. Despite this growing demand, job postings rarely include explicit indicators of whether a role is AI-driven, making it difficult to analyze the impact of AI on the labor market. Additionally, "this challenge is further compounded by the dynamic nature of the global economy, which continually reshapes the demand for specific job roles and skill sets" [1]. This was our motivation to create a model which understands how AI affects job postings is crucial for job seekers to anticipate workforce trends and align educational and economic planning with emerging technologies. Simultaneously, "employers encounter obstacles in efficiently identifying and recruiting applicants who possess the most relevant competencies for their organizational needs" [1].

The objective of this project was to automatically identify AI related jobs and analyze trends within the job market using machine learning techniques. Rather than using manual human analyzation, our work proposes a keyword-based proxy labeling strategy combined with supervised classification models. Our study evaluates multiple algorithms to assess their effectiveness in identifying AI-driven employment patterns. As Purohit et al. observe, "artificial intelligence (AI) and automation are influencing the modern job market" with significant implications for "compensation, skill requirements, and job growth" [7]. Additionally,

the model analyzes feature importance and temporal trend evaluation to better understand which job characteristics are most closely associated with AI-related roles and how they evolve over time.

2. Related Studies

Prior research has explored the relationship between technological advancement and employment trends, with an emphasis in software engineering and automation-driven fields. Studies such as Frey and Osborne (2017) analyzed job susceptibility to automation, concluding that roles involving creativity and complex problem-solving are less likely to be replaced. Similarly, Acemoglu and Restrepo (2020) emphasized that automation often shifts job responsibilities rather than eliminating positions entirely.

More recent work has focused on AI-specific labor impacts. As Jagannathan et al. note, "forecasting changes to labor markets is being driven by the pervasive impact of disruptive technologies on economies and societies" [4]. While "this preoccupation was triggered by fears that new technologies such as artificial intelligence and robotics will displace people in the work place, it is now tempered with a more balanced view that loss of jobs will be accompanied by gains in increase in productivity, creation of new jobs and the combined application of technology and human skills" [4]. Chole et al. further acknowledges "the fact that AI adoption is both a benefit and a threat that calls for careful executive actions on best strategies for managing changes in the workforce" [2]. Their research found that "AI adoption corresponds to higher wages particularly in the advanced skill jobs but the jobs at high automation risk enjoy wage premium due to job insecurity" [2]. Kaggle-based labor market analyses have demonstrated that demand for AI-related skills fluctuates significantly based on economic conditions and industry adoption rates. Other studies have applied machine learning classifiers to job descriptions to extract skill trends and forecast hiring demand.

This project builds prior work by combining classification and forecasting approaches. Unlike studies that rely solely on descriptive statistics, our approach integrates ensemble learning and time-series modeling to both identify AI-related roles and predict future changes. Additionally, feature importance analysis provides insight into which job attributes most influence AI classification.

3. Proposed Method

The dataset used in this project was obtained from Kaggle and consists of approximately 15,000 simulated CS-related job postings from 2024 to 2025, based on real-world job data. Each record contains attributes such as job title, company name, posting date, required skills, experience level, and industry. Our Data preprocessing included removing duplicate postings, handling missing values, normalizing textual fields, encoding categorical features, and creating a binary label indicating whether a job was AI-related

To classify AI-related job postings, a stacked ensemble model was implemented. The ensemble combines Random Forest, which captures nonlinear feature interactions and XGBoost, which provides gradient-boosted decision trees optimized for performance.

The outputs of both models were combined to generate final predictions. This approach was selected to leverage the strengths of both algorithms and improve robustness.

```
=== STACKED MODEL (Random Forest + XGBoost) ===
Accuracy: 0.9712
              precision    recall  f1-score   support

           0       1.00      0.84      0.91       673
           1       0.97      1.00      0.98      3077

    accuracy                           0.97      3750
   macro avg       0.98      0.92      0.95      3750
weighted avg       0.97      0.97      0.97      3750
```

Figure 3.1

Feature importance scores were extracted from both models and aggregated to identify the most influential factors. Features such as job title keywords, AI-related skills (e.g., deep learning, NLP), and required experience level ranked highest.

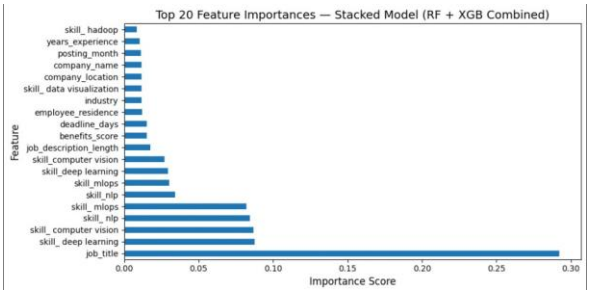

Figure 3.2

After classification, Prophet was used to model and forecast monthly trends in AI-related job postings. Prophet was selected due to its ability to handle seasonality, trend changes, and missing data effectively.

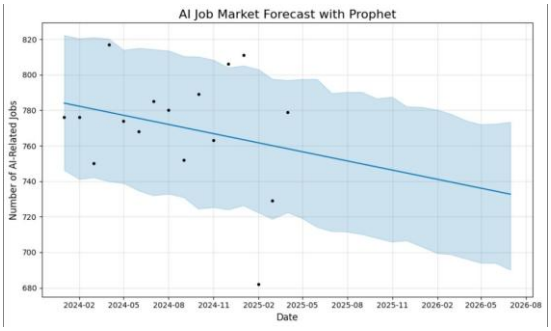

Figure 3.3

4. Experiments and Results

To evaluate the effectiveness of the proposed classification approach, multiple models were trained and tested on a held-out test set using a 75/25 train–test split. Performance was primarily assessed using accuracy, precision, recall, and F1-score in order to account for class imbalance between AI-related and non-AI job postings.

The stacked ensemble model, combining Random Forest and XGBoost, achieved an overall accuracy of 97.12%, significantly outperforming baseline models such as Logistic Regression. The weighted F1-score of 0.97 indicates that the model maintains strong predictive performance across both classes, even with a substantially larger number of AI-related postings compared to non-AI postings.

While accuracy alone could be misleading due to class imbalance, the stacked model demonstrated high precision and recall for the AI-related class, suggesting that it is effective at correctly identifying AI-focused roles without excessively misclassifying non-AI positions. Compared to individual models, the ensemble benefited from the complementary strengths of Random Forest's robustness to noisy features and XGBoost's ability to capture complex nonlinear relationships. These results confirm that ensemble learning is well-suited for high-dimensional job market data containing both categorical and text-derived features.

The Prophet forecasting model indicates a gradual decline in explicitly AI-labeled job postings over the next several years. However, the confidence intervals suggest uncertainty, and the overall CS job volume remains relatively stable. This implies that AI skills are increasingly embedded into general CS roles rather than appearing as standalone positions.

5. Conclusion

This project explored the use of supervised machine learning techniques to identify and analyze AI-related job postings within a large-scale employment dataset. By using a keyword proxy labeling system and evaluating multiple classification models, the study demonstrated that ensemble and tree-based methods can effectively distinguish AI driven roles from non-AI driven roles. Feature importance analysis and temporal trend evaluation provided additional insight to how AI related positions evolve over time and how they relate to the broader labor market.

The results show that the number of jobs which involve AI-related roles is projected to decline over the observed period. This shift does not appear to impact non-AI related roles. Instead, AI-specific positions seem to change independently of broader employment trends, indicating that the implementation of AI may be reshaping certain roles rather than broadly displacing non-AI jobs. These findings support the idea that AI's influence on the job market is more nuanced than simple job

replacement and instead reflects changing skill requirements within specific sectors.

Despite these insights, some limitations should be acknowledged. The AI impact label was derived using a keyword-based proxy rather than manually verified ground truth, which may introduce labeling noise or bias. Additionally, the dataset represents a snapshot of online job postings which may not capture long-term labor market trends or informal employment sectors. The perfect classification performance observed in some models also suggests potential overfitting or strong alignment between proxy labels and features.

Future work could address these limitations by incorporating natural language processing techniques such as word embeddings or transformer-based models to capture deeper semantic meaning in job descriptions. Expanding the dataset across longer timeframes and validating labels through expert review would also further strengthen the analysis. Finally, integrating time-series forecasting models could provide more robust projections of AI-related employment trends and their long-term implications for the workforce.

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