

“Analyzing Key Determinants of Oncampus Placement: A Machine Learning Approach”

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Abstract

Oncampus placement plays a crucial role in shaping students' career trajectories and institutional reputation. Identifying key determinants influencing placement outcomes enables educational institutions to improve training strategies and student preparedness. Traditional statistical analyses often fail to capture nonlinear relationships among academic, technical, and behavioral attributes affecting employability. This paper presents a machine learningbased framework for analyzing and predicting oncampus placement outcomes. The proposed system integrates feature engineering, classification models, and interpretability techniques to identify significant predictors of placement success. Experimental results demonstrate improved predictive performance using ensemble learning methods compared to traditional baseline models. The findings provide actionable insights for institutions to enhance placement readiness programs.

Keywords: Campus Placement Prediction, Employability Analytics, Machine Learning, Classification, Feature Importance, Educational Data Mining

I. INTRODUCTION

Campus placement is a critical milestone for students pursuing higher education, particularly in professional courses. Educational institutions aim to maximize placement rates to enhance reputation and industry partnerships. Understanding the factors influencing placement outcomes is essential for designing effective academic and training programs.

Traditional analyses of placement data rely on descriptive statistics and regression models. However,

these approaches may not effectively model complex interactions among academic performance, technical skills, internships, and soft skills. Recent studies in 2023 and 2024 demonstrate that machine learning techniques provide improved predictive accuracy and deeper insights into employability analytics [1], [2].

Ensemblebased predictive models have shown strong performance in educational data mining applications [3]. Furthermore, explainable AI methods enable identification of key determinants influencing placement decisions [4]. Motivated by these advancements, this paper proposes a machine learning framework for analyzing determinants of oncampus placement success.

II. RELATED WORK

Recent research from 2023–2026 highlights the application of machine learning in educational analytics and employability prediction. In [1], supervised learning models were used to predict student placement outcomes based on academic and extracurricular features. Similarly, [2] proposed a hybrid ensemble model for predicting employability with improved generalization.

Feature importance analysis has been emphasized to identify influential determinants. A 2024 study in [3] applied Random Forest and Gradient Boosting models to rank academic and behavioral attributes affecting placement. Explainable AI approaches for educational data were explored in [4], enabling transparent prediction models.

Additionally, research in [5] integrated soft skill assessment metrics and internship experience into predictive models, demonstrating improved accuracy.

Scalable predictive frameworks for institutional decision support were discussed in [6], focusing on realtime analytics and datadriven intervention strategies.

These studies provide a foundation for developing a machine learningbased framework to analyze oncampus placement determinants.

III. METHODOLOGY

The proposed framework consists of data collection, preprocessing, feature engineering, model training, evaluation, and interpretability analysis.

The dataset includes student records containing academic performance metrics such as GPA, semester grades, attendance percentage, and backlogs. Additional attributes include internship experience, certification courses, technical skill scores, aptitude test scores, communication skills rating, and participation in extracurricular activities.

Data preprocessing involves handling missing values, encoding categorical variables, and normalizing numerical features. Feature

engineering includes deriving cumulative academic scores and skillbased indicators. The dataset is divided into training and testing sets.

Multiple machine learning classification algorithms are implemented, including Logistic Regression, Decision Tree, Random Forest, Support Vector Machine, and Gradient Boosting. Hyperparameter tuning is conducted using crossvalidation to optimize performance.

Feature importance is analyzed using ensemble models and SHAPbased interpretability techniques to identify key determinants influencing placement outcomes.

The workflow of the system is described as follows:

- Student Dataset Collection
- Data Cleaning and Feature Engineering
- Model Training and CrossValidation
- Placement Outcome Prediction
- Feature Importance Analysis
- Performance Evaluation

Evaluation metrics include accuracy, precision, recall, F1score, and Area Under the ROC Curve.

IV. RESULTS AND DISCUSSION

Experimental results indicate that ensemble models such as Random Forest and Gradient Boosting outperform linear models in predicting placement outcomes. The models achieve high predictive accuracy and strong Area Under the ROC Curve values.

Feature importance analysis reveals that GPA, internship experience, technical skill scores, and aptitude performance are among the strongest predictors of placement success. Soft skills and communication ratings also contribute significantly to prediction outcomes.

Interpretability analysis provides actionable insights for institutions, enabling targeted training interventions for students with lower predicted placement probabilities.

However, model performance depends on the quality and completeness of institutional data. Ethical considerations regarding student data privacy must also be addressed.

V. CONCLUSION AND FUTURE WORK

This paper presented a machine learningbased framework for analyzing key determinants of oncampus placement. The proposed system demonstrates improved predictive accuracy and identifies critical factors influencing employability outcomes.

Future work includes integrating deep learning models for largescale educational datasets, incorporating sentiment analysis from interview feedback, implementing realtime predictive dashboards for placement cells, and enhancing fairnessaware modeling to ensure unbiased predictions.

VI. REFERENCES

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