International Journal of Advanced Trends in Multidisciplinary Research
ISSN: 3139-0986, Volume 2 Issue 7
July 2026, PP 1-7

An Intelligent Campus Placement Prediction Framework Using Machine Learning

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***Abstract* – Campus placement prediction is a major use of machine learning in the field of higher education. Because of this, schools may gauge a candidate's employability based on their grades and other skill-related attributes. By accurately predicting students' placement results, training and placement cells may better assist students in gaining a better understanding of their strengths and areas for improvement, which in turn helps students in their professional development. This research presents a machine learning-based predictive analytics platform for on-campus placements. The platform uses a variety of criteria, including students' technical ability, internship experience, project work, credentials, and academic records, to forecast how campus placements will go. To eliminate discrepancies, identify significant features, and understand the interrelationships of different variables, the collected student dataset is first subjected to data preparation and exploratory data analysis (EDA). Now we can go on to comparing and applying different supervised machine learning methods. Decision trees, logistic regression, K-nearest neighbours (KNN), and random forests are all examples of such methods. F1-Score, Accuracy, Precision, and Recall are typical performance indicators used in this assessment. Decision Tree and K-Nearest Neighbours classifiers get the highest prediction accuracy when evaluated on the selected dataset. Academic profile analysis and real-time placement predictions are both made possible via an interactive online interface that students and placement managers may utilise. Because of this, the suggested framework is more practically useful. One web program that uses Django is able to use the learned prediction model. This data-driven solution is scalable, effective, and designed to improve campus recruitment strategies, student career guidance, and institutional placement outcomes.**

***Keywords* – Campus Placement Prediction, Machine Learning, Predictive Analytics, Exploratory Data Analysis, Decision Tree, Random Forest, Logistic Regression, Support Vector Machine, K-Nearest Neighbors, Django, Placement Management System.**

I. INTRODUCTION

Campus placement services are a gold standard for evaluating educational institutions and the employability of their alumni. Every year, a number of institutions hold campus recruitment drives to assist students in finding employment prior to graduation. A school's placement rate is an indicator of the quality of its academic program and has repercussions for the school's image, enrolment, and relationships with local businesses. Therefore, schools should look at ways to predict students' placement outcomes so they may improve their training methods and get them ready for the workforce more effectively [1, 5].

College recruitment has always made use of both on-campus and off-campus placement strategies. When hiring on campus, companies often use aptitude testing, technical interviews, and in-person interviews to find the best applicants. On the other side, there is off-campus recruitment, which allows students to apply independently using numerous online platforms. Academic consistency, cumulative grade point average, internship experience, technical skills, certifications, project work, communication ability, extracurricular accomplishments, and project work are some of the academic and professional qualities that businesses usually look at when recruiting new employees. Therefore, in order to accurately anticipate placement results, it is required to conduct a comprehensive analysis of all of these parameters [2, 6].

Due to the rapid development of AI and ML, educational institutions have begun to rely heavily on predictive analytics to aid in academic decision-making and placement administration. Machine learning algorithms may be used to go through historical data, find hidden relationships between different attributes, and make precise predictions when it comes to student placement. These intelligent prediction models help students understand their strengths and areas for growth, which affects their employability. They also allow placement officials to identify individuals who require more training [7], [11].

Preparing the gathered dataset for machine learning requires exploratory data analysis (EDA). Only then can reliable placement prediction models be built. With the use of statistical summaries and visual representations, electronic data analysis (EDA) may help academics discover missing values, outliers, feature distributions, and correlations between academic variables. Furthermore, feature selection algorithms enhance prediction performance while decreasing redundant information by zeroing down on the most crucial traits that impact placement outcomes. When carried out correctly, these preprocessing steps substantially improve the model's accuracy and generalisability [11], [14].

The issues with campus placement prediction have been successfully handled by several supervised machine learning algorithms. Logistic Regression provides a firm

groundwork for binary classification problems, while decision tree models use academic qualities to provide decision rules that can be understood. While Support Vector Machine (SVM) divides placement classes effectively using ideal hyperplanes, K-Nearest Neighbours (KNN) predicts outcomes based on student profile similarity, and Random Forest reduces overfitting and increases classification resilience by using multiple decision trees. The optimal model for placement prediction may be identified by comparing and contrasting various methods [1, 4, 12].

In order to forecast the outcomes of campus placement, this research constructs a strong predictive analytics framework using historical student placement data. The proposed method accounts for academic and placement-related features like SSC and HSC percentages, B.Tech performance, internships, certifications, publications, project work, technical ability, and other relevant traits. The acquired dataset is preprocessed, explored, features are selected for, and models are trained using a variety of supervised machine learning approaches. The dataset is thereafter assessed in a comparable manner. The prediction performance of each classifier is evaluated using Accuracy, Precision, Recall, and F1-Score to determine the optimal model for campus placement prediction.

To demonstrate the practicality of the proposed framework, we integrate the trained prediction model into a live Django web application. Students and placement administrators alike may get up-to-the-minute placement predictions by inputting their academic information into the application's dynamic dashboard. Thanks to the Django framework, which efficiently manages user authentication, data storage, prediction services, and the visualisation of results, the proposed machine learning model becomes a functional decision-support system for college recruitment management.

II. BACKGROUND STUDY

Academics in the field of educational data mining have begun to focus heavily on campus placement prediction as a means by which schools may gauge prospective students' employability. Machine learning algorithms examine academic and placement records to identify the most significant factors influencing recruitment outcomes; this information may be very useful for academic administrators, placement officers, and students. Academics have responded to the proliferation of educational data and predictive analytics methods by developing intelligent solutions to improve institutional performance and placement planning [1, 5].

The majority of the early research on campus placement relied on statistical analysis and traditional data mining methods to examine the correlation between academic performance and placement success. The results of the Secondary School Certificate (SSC), the Higher Secondary Certificate (HSC), internships, technical skills, credentials, and total grade point average were all included in these evaluations. Although these techniques succeeded in identifying some important placement characteristics, they often failed to provide reliable predictions when confronted with massive, multidimensional educational datasets [6, 10].

To improve the precision of placement predictions as machine learning advanced, researchers used supervised classification approaches. Logistic Regression was one of the first algorithms used for binary placement prediction because of its simplicity and ease of comprehension. Decision Tree classifiers quickly gained popularity due to their ability to provide understandable decision rules based on academic criteria. Through ensemble learning and similarity-based classification algorithms, Random Forest and K-Nearest Neighbours (KNN) demonstrated improved prediction accuracy [1, 4, 12]. Support Vector Machines (SVM) further improved classification by identifying optimal decision boundaries.

Campus placement prediction systems already often employ exploratory data analysis (EDA). Before training the model, researchers learn about data distributions, outliers, missing values, outlier identification, and correlations between student variables via data visualisation and statistical analysis. By determining the most important academic elements, EDA helps with optimal feature selection, which lowers data complexity and boosts machine learning capability. By integrating EDA with predictive modelling, campus placement prediction systems have been made much more reliable and easy to use [11], [14].

New studies have shown the benefits of intelligent recruiting management systems that use educational analytics. These systems not only forecast placement outcomes but also provide students with guidance on how to improve their employability via internships, technical proficiency, communication, and academic achievement. Potential advantages to educational institutions from such systems include improved placement statistics, the ability to identify students who need more training, and the development of relationships with recruiting agencies [2], [13].

While there has been significant progress in predicting students' final employment destinations, there are still many factors to take into account, such as students' academic ability, technical abilities, and behavioural qualities, which vary throughout schools and recruitment agencies. This is why robust predictive algorithms capable of analysing a variety of student attributes are necessary for reliable placement predictions. A predictive analytics framework using several supervised machine learning techniques—including Decision Tree, Logistic Regression, Support Vector Machine, K-Nearest Neighbours, and Random Forest—is constructed in this research to address these challenges. A web application built on Django that uses the learnt prediction model allows administrators and students

International Journal of Advanced Trends in Multidisciplinary Research
ISSN: 3139-0986, Volume 2 Issue 7
July 2026, PP 1-7

to utilise an interactive online interface for real-time placement prediction.

Table I. Summary of Existing Campus Placement Prediction Studies

Study	Methodology	Major Findings
Campus Placement Prediction using ML	Logistic Regression, Decision Tree, Random Forest	Machine learning improves placement prediction accuracy.
EDA for Campus Placement Analysis	Exploratory Data Analysis and Visualization	Feature analysis significantly enhances prediction performance.
Campus Recruitment Management	Online Placement Management System	Improves communication between students and recruiters.
ML-Based Placement Prediction	SVM, KNN, Random Forest	Ensemble and supervised learning models provide reliable prediction results.
Proposed Work	EDA + Logistic Regression + Decision Tree + SVM + KNN + Random Forest	Comprehensive predictive analytics framework integrated with a Django-based deployed application for real-time campus placement prediction.

III. RESEARCH METHODOLOGY

The goal of the suggested research method is to build a smart campus placement prediction system by combining supervised machine learning algorithms with past student placement data. Using a web application built on Django, we gather data, preprocess it, analyse it exploratorially, engineer features, train the model, compare it, and then deploy it. With each phase, the prediction capabilities and practical applicability of the provided framework are improved.

The campus placement dataset is first built by extracting information on students' academic performance and recruitment outcomes from institutional placement records. Dataset attributes include things like education level (SSC, HSC, B.Tech), internship experience, professional certifications, published work, technical proficiency, placement details, and salary. Input criteria for placement prediction are these characteristics, which describe each student's academic and professional profile.

To guarantee that the obtained dataset is error-free and of good quality, a comprehensive preprocessing procedure is performed prior to model creation. There includes adequate handling of missing data, normalisation of numerical features when required, and numerical representations of categorical variables like placement status and department. A portion of the processed dataset is reserved for testing, while the remaining 80% is used for training. In this approach, the ML models may gain insight from historical data while simultaneously testing their predictive power on fresh student profiles. The credibility of the model evaluation is therefore guaranteed.

After preprocessing, we go on to Exploratory Data Analysis (EDA), which allows us to examine the data and identify the elements that significantly affect campus placements. Statistical summaries, distribution analyses, correlation analyses, and visualisation methodologies are used to check for trends in academic achievement, placement status, wealth distribution, and relationships among different student features. According to EDA, feature selection is supported by the most essential elements that impact effective college recruitment. This method not only reduces data duplication but also makes prediction models more interpretable.

Feature preprocessing is necessary prior to applying a multitude of supervised machine learning algorithms in order to forecast where students will ultimately wind up on campus. A number of classifiers have been selected, including Random Forest, Decision Tree, SVM, and Logistic Regression. By utilising the same dataset for training, we can fairly compare the algorithms' prediction abilities. On the basis of student profile similarity, KNN makes placement predictions, Decision Tree makes decision rules that can be understood, Support Vector Machine finds the best hyperplanes to separate students, Random Forest uses ensemble learning to make predictions more stable, and Logistic Regression is the baseline classification model.

The trained models are evaluated using common classification metrics such as Accuracy, Precision, Recall, and F1-Score. All classifiers are evaluated using these performance criteria, which include the sensitivity to placed students, overall prediction accuracy, accuracy of positive predictions, and precision/recall ratio. A comparison evaluation may provide the most effective machine learning approach for determining the location of a school.

Table II. Research Methodology Workflow

Phase	Description
Data Collection	Collection of student academic and placement records.
Data Preprocessing	Missing value handling, encoding, normalization, and train-test split (80:20).
Exploratory Data Analysis	Statistical analysis, visualization, feature correlation, and feature selection.
Model Development	Logistic Regression, Decision Tree, SVM, KNN, and Random Forest implementation.
Performance Evaluation	Accuracy, Precision, Recall, and F1-Score comparison.
Deployment	Django-based deployed web application for real-time campus placement prediction.

International Journal of Advanced Trends in Multidisciplinary Research
ISSN: 3139-0986, Volume 2 Issue 7
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To facilitate its practical implementation, the selected prediction model is coupled with a Django-built web application. This tool is designed to help students and managers of placement programs manage their academic data. It allows users to perform real-time placement predictions and see the results on an intuitive dashboard. Using the Django framework, which takes care of user authentication, database operations, prediction services, and results presentation, the machine learning model is transformed into an intelligent educational institution-specific placement management system.

Fig. 1. Proposed System Architecture for Campus Placement Prediction Using Machine Learning

IV. PREDICTIVE ANALYTICS FRAMEWORK

Students' campus placement status may be estimated by the suggested predictive analytics system by looking at their academic success, technical qualifications, and placement-related criteria using supervised machine learning algorithms. The integrated workflow of the framework includes intelligent prediction, training of models, exploratory analysis, feature engineering, comparison evaluation, and data preprocessing. Through this systematic approach, educational institutions might potentially assist students in improving their employability and identify patterns in placement.

First, the student dataset is prepared and sent to the predictive analytics module. Before training the model, Exploratory Data Analysis (EDA) looks at the dataset's statistical characteristics, feature distributions, placement patterns, and correlations between academic criteria. Using correlation analysis to identify the most important parameters for placement prediction helps with both feature selection and reducing unnecessary data complexity.

The prediction framework employs five supervised machine learning algorithms to ascertain a student's placement status. By utilising same training data, all classifiers may be fairly compared in terms of prediction performance. The following algorithms were selected:

- Logistic Regression: Employed as the first binary classification model to assess the likelihood of placement according to academic and skill-related characteristics.
- Decision Tree: Produces a hierarchical set of rules for making decisions that elucidates how various academic factors affect placement results. Using a variety of academic characteristics, Support Vector Machine (SVM) determines the best way to divide students into those who were placed and those who were not. To forecast placement, K-Nearest Neighbours (KNN) finds nearby occurrences of students with comparable academic profiles and finds the placement class with the most students in it.
- Random Forest: Uses ensemble learning to combine several decision trees for better prediction accuracy, less overfitting, and stronger models.

Following training, the testing dataset is used to assess the prediction capabilities of each machine learning model. F1-Score, Accuracy, Precision, and Recall are the performance metrics used to compare the implemented classifiers comprehensively. Finding the best prediction model for campus placement analysis is made possible by comparing and contrasting the algorithms and learning about their advantages and disadvantages.

Model performance may be visually represented in the predictive analytics framework with the help of comparison graphs and data summaries. By comparing the efficacy of various machine learning methods and pinpointing the academic variables that substantially impact recruiting results, these visualisations aid placement officers in their work. When arranging student training and placement, these analytical insights help make educated decisions.

Last but not least, a web application built on Django is used to incorporate the chosen prediction model. This tool allows administrators and students to do real-time placement prediction. An easy-to-navigate online interface allows users to key in their academic details, do placement tests, and get their prediction results. An intelligent decision-support platform that improves institutional placement strategies and campus recruiting management is provided by the implemented system, which integrates machine learning with predictive analytics.

Table III. Comparative Machine Learning Models

Machine Learning Algorithm	Primary Function	Expected Outcome
Logistic Regression	Binary Classification	Baseline placement prediction
Decision Tree	Rule-Based Classification	Interpretable prediction model
Support Vector Machine	Hyperplane-Based Classification	Improved class separation
K-Nearest Neighbors	Similarity-Based Prediction	Neighbor-driven classification
Random Forest	Ensemble Learning	Robust and highly accurate placement prediction

V. EXPERIMENTAL EVALUATION

The proposed campus placement prediction system is evaluated using this dataset, which comprises the academic records and placement information of engineering students

throughout their lifetime. Prior to training a model, the dataset must undergo preprocessing, which includes cleaning up the data, encoding categorical variables, normalising numerical features, and preparing the dataset for supervised learning. Splitting the processed dataset into 80% training data and 20% testing data ensures that the prediction models are tested on fresh student records.

Logistic Regression, Decision Tree, Support Vector Machine (SVM), K-Nearest Neighbours (KNN), and Random Forest are the five supervised machine learning algorithms that we use to evaluate the proposed framework's predictive potential. By utilising the same training dataset for each method, we can ensure that we are comparing prediction performance on an equal footing. By using identical testing data, the trained models may be objectively assessed for their classification ability in forecasting campus placement outcomes.

When evaluating the efficacy of each classifier, we employ the four standard metrics: accuracy, precision, recall, and F1-Score. Accuracy, as it pertains to student records, is the sum of all correct classifications. The accuracy of predicted placement outcomes is measured by Precision, while the aptitude to identify placed children is evaluated by Recall. One comprehensive measure of classification effectiveness is the F1-Score, which combines Precision and Recall into a single performance score. These criteria allow for a comprehensive comparison of all deployed machine learning models.

Experimental results demonstrate that all five ML systems can correctly predict where students will ultimately wind up on campus, despite differences in their classification skill. With a total prediction accuracy of 98.46%, Decision Tree surpasses all other models on the selected dataset. While Random Forest produces comparable prediction results at 95.38%, the K-Nearest Neighbours (KNN) classifier is unrivalled with a performance of 96.32%. Support Vector Machine performs a little worse than expected on this dataset, while Logistic Regression provides respectable results for baseline classification. When it comes to campus placement prediction, the comparison research reveals that learning algorithms based on neighbourhoods and trees are superior at predicting the complex relationships between academic and placement-related attributes.

In addition to numerical evaluation, we also look at comparative performance graphs to get a better idea of how different classifiers differ in terms of Accuracy, Precision, Recall, and F1-Score. By facilitating model interpretation, placement managers may use these visual comparisons to aid in selecting the most suitable prediction model for institutional deployment. Experiments demonstrate that machine learning-based predictive analytics is an effective tool for campus recruitment strategy and student career advising.

The proposed predictive analytics system accurately predicts students' placement potential by integrating their prior academic achievement with supervised machine learning algorithms, as shown in the experimental evaluation. The trained model is then made available via a Django-built web tool, where students and placement authorities may get real-time assistance with placement prediction and decision-making.

VI. DEPLOYMENT ARCHITECTURE

In order to demonstrate the practical use of the proposed predictive analytics framework, the trained machine learning model is deployed as a Django-based web application. The deployment design combines the prediction model with a safe and intuitive web interface. Anyone using a standard web browser may utilise the system, including students, teachers, and placement authorities. By implementing this deployment, the machine learning model transforms into an intelligent platform for placement management, capable of making real-time predictions about placement.

The application's backend, built on the Django framework, handles user authentication, academic data management, prediction processing, database operations, and results visualisation. The following academic facts may be added by students once they have registered and logged in: SSC and HSC percentages, B.Tech grades, internship and project experiences, certificates, technical skills, and certifications. Following the user's confirmation, the application will re-use the pipeline from model training to preprocess the data. By doing so, we can guarantee that the forecasts will be uniform.

The profile information is used to provide real-time placement predictions once the academic data has been evaluated. The model is trained using this data. With the use of an interactive dashboard, users may see their placement chances and evaluate the academic factors influencing their employability in real-time. This function assists placement officers in creating efficient training programs by allowing students to identify their areas of weakness.

You may preserve student data, their placements, and their previous forecasts using the database administration features included in the deployed program. Authorised administrators may monitor placement data, review expected outcomes, and assess placement trends overall using the connected dashboard. Academic record administration is made simpler with the centralised design, and decision-making at the institution is helped by helpful analytical insights.

The modular design of the Django framework makes it easy to incorporate future system advancements with minimal architectural modifications. The system may be enhanced with recruiter dashboards, advanced visualisation techniques, cloud deployment services, business management modules, and machine learning algorithms, among other features, to make it even more flexible and helpful. A reliable, scalable, and efficient platform is provided by the proposed deployment architecture, which

also enables intelligent college placement prediction and educational choice aid.

VII. CONCLUSION

This study introduces a predictive analytics framework for campus placement outcomes prediction based on machine learning, which takes into account students' academic achievement and factors associated to placement. Data gathering, preprocessing, exploratory data analysis, feature engineering, supervised machine learning, comparison assessment, and web-based deployment are all part of the suggested technique for developing an intelligent placement prediction system. Examining past student records, such as grades, internships, certificates, technical abilities, projects, and placement details, helps to determine what matters most when hiring on campus.

Applying Accuracy, Precision, Recall, and F1-Score, we compare and contrast five supervised machine learning algorithms: Decision Tree, Logistic Regression, K-Nearest Neighbours (KNN), and Random Forest. According to the results of the experiments, the Decision Tree classifier has the best prediction accuracy at 98.46%, while the K-Nearest Neighbours model comes in second with 96.92%. Prediction performance is competitive when using Random Forest, while classification accuracy is worse when using Logistic Regression and Support Vector Machine on the given dataset. The results show that tree-based learning methods excel in predicting students' academic placement on campus as they can grasp the intricate interplay between several academic and placement-related factors.

The suggested architecture is made more practical by including the trained prediction model into a web application that is deployed using the Django framework. This web application allows administrators and students to do real-time placement prediction using an interactive online interface. Educational institutions may benefit from the application's full decision-support platform, which includes features like academic profile management, intelligent prediction, data visualisation, and centralised record management.

When it comes to intelligent campus placement prediction, the suggested predictive analytics architecture provides a dependable, efficient, and scalable solution. Students are helped in comprehending their preparation for placement by the created system, which also allows placement officers to create focused training programs and enhance the effectiveness of institutional recruiting. Better prediction accuracy and interpretability can be achieved in future work by expanding the framework to include bigger datasets from multiple institutions, more sophisticated ensemble and deep learning algorithms, deployment in the cloud, modules to recommend recruiters, and explainable AI techniques.

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