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Comparative Analysis of Academic Performance and technical skills in predicting Engineering Graduate Placement outcomes

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Abstract

Graduate placement prediction has become an important matter of concern due to increasing competition in jobs. Educational institutions aim to identify the factors that influence students' employability so that updated interventions can improve placement outcomes. This study presents a comparative analysis of academic skills and technical skills in predicting engineering graduate placement using machine learning techniques. The study contain an engineering student placement dataset containing academic records, technical competencies, internships, certifications, communication skills, aptitude scores, attendance, projects, and extracurricular activities. Comparative analysis of performances which contribute more academic performance or technical skills may give efficient results by ensemble models than traditional classification algorithms. This study will be more helpful for the students by knowing their ability, interests, performances so that students can recognize their participations in area of interests by prediction and easily employed.

Introduction

As population is increasing, so it's a difficult task to placed a job without skills so it is necessary to focus on extracurricular activities (skills, internship, performance) so that placement can be easy.

We must pay attention on both qualifications, degrees as well as on technical skills both factors equally contribute in employability. Majority of theories states that importance of education as one of the pillar in human capital formation that gives efficient outcomes economic development and productive growth.

Literature Review

Recent years have seen a shift towards ML techniques for predicting students placements. A common reason for choosing engineering career it leads to quick career success in terms of improved salary and success. Students from reputed institutions are more likely to get progress at early stages.

II. Literature Review

Machine learning has become an important tool for predicting students' academic performance and graduate employability. Educational institutions increasingly use predictive analytics to identify the factors influencing placement outcomes and to support timely academic interventions. Various supervised learning algorithms have demonstrated promising results in analyzing educational

datasets and forecasting students' career prospects [1].

Several researchers have reported that academic indicators such as CGPA, Class X and XII scores, and attendance significantly influence students' academic success and placement opportunities. However, recent studies indicate that technical competencies, including programming skills, internships, project experience, certifications, and communication skills, are equally important in improving employability, particularly in engineering disciplines [2], [8].

Educational Data Mining (EDM) and Machine Learning (ML) techniques have been successfully applied to classify students based on their academic records and predict future outcomes.

Algorithms such as Logistic Regression, Decision Tree, Random Forest, Support Vector Machine, and ensemble methods have been widely adopted because of their ability to learn complex relationships among multiple variables and provide reliable prediction accuracy [3], [4].

Recent research has also shown that combining academic achievements with practical and technical skills results in more accurate placement prediction models than relying on academic performance alone. Employers increasingly seek graduates who possess strong analytical abilities along with problem-solving, teamwork, communication, and technical expertise required in modern workplaces [8], [9].

Based on the findings of previous studies, the present research performs a comparative analysis of academic performance and technical skills using machine learning algorithms to determine their individual and combined contributions to engineering graduate placement prediction.

Research Methodology

It is the systematics, theoretical plan used to conduct a study. It decides how data is collected, processed and analyzed to answer research objective it ensures a study is valid, reliable and replicable. It is a systematic and formal way to solve a particular research problem.

Methodology used: hybrid analysis (uses qualitative and quantitative analysis) Sampling

method : Kaggle

Data collected: structured Analytical tools Jupiter lab notebook

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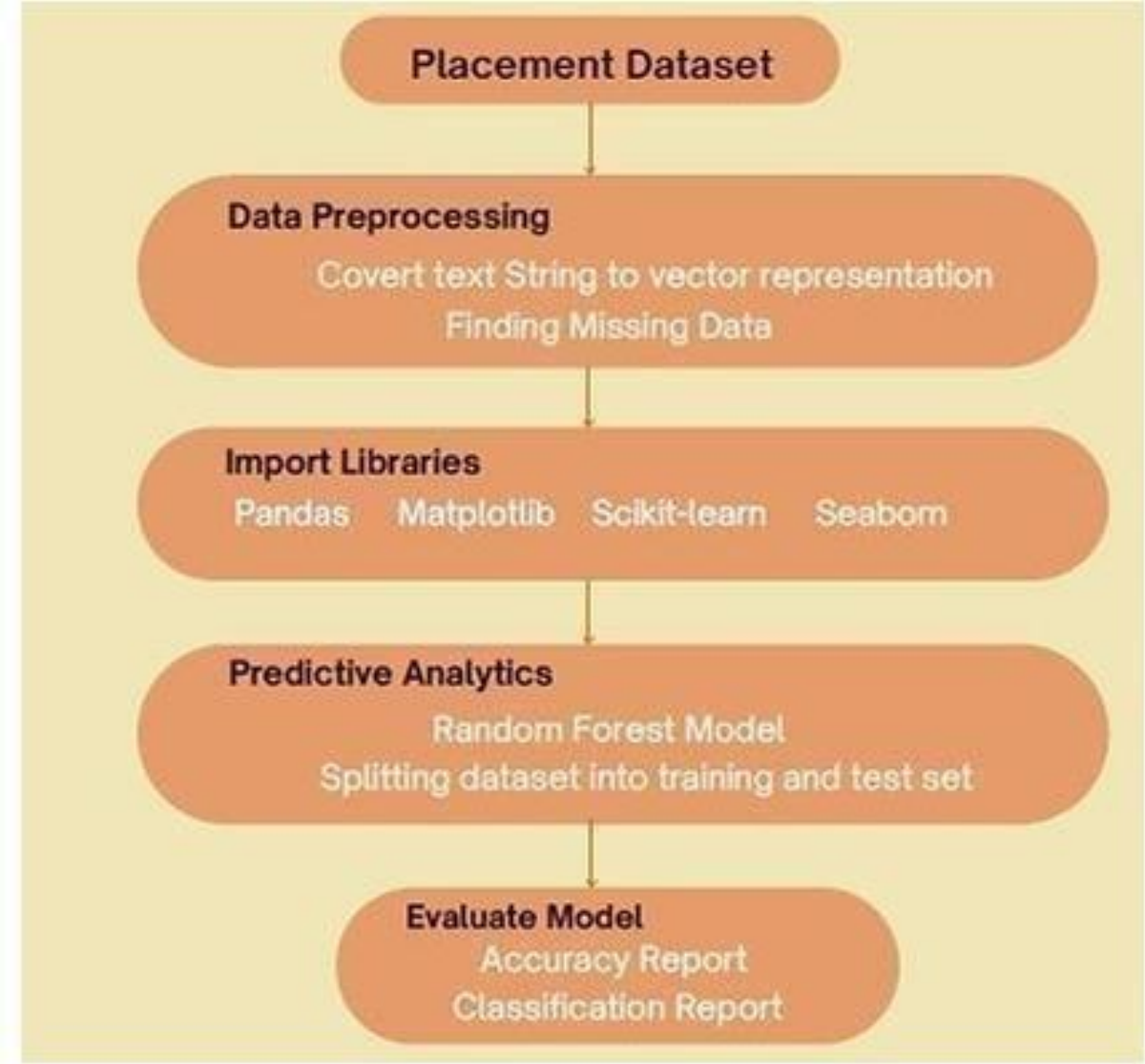

Fig. 4. Flow of the proposed model.

Step 1: Data Preprocessing

Handle misplaced or lost values, encode qualitative variables, normalize quantitative values.

Step 2: Feature Segregation

Analytical features : qualifications, certifications

Technical features : coding skills, project, problem solving ability. Step 3: Comparative Analysis

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Correlation heatmaps, pivot tables, bar graphs Step 4: Model Testing

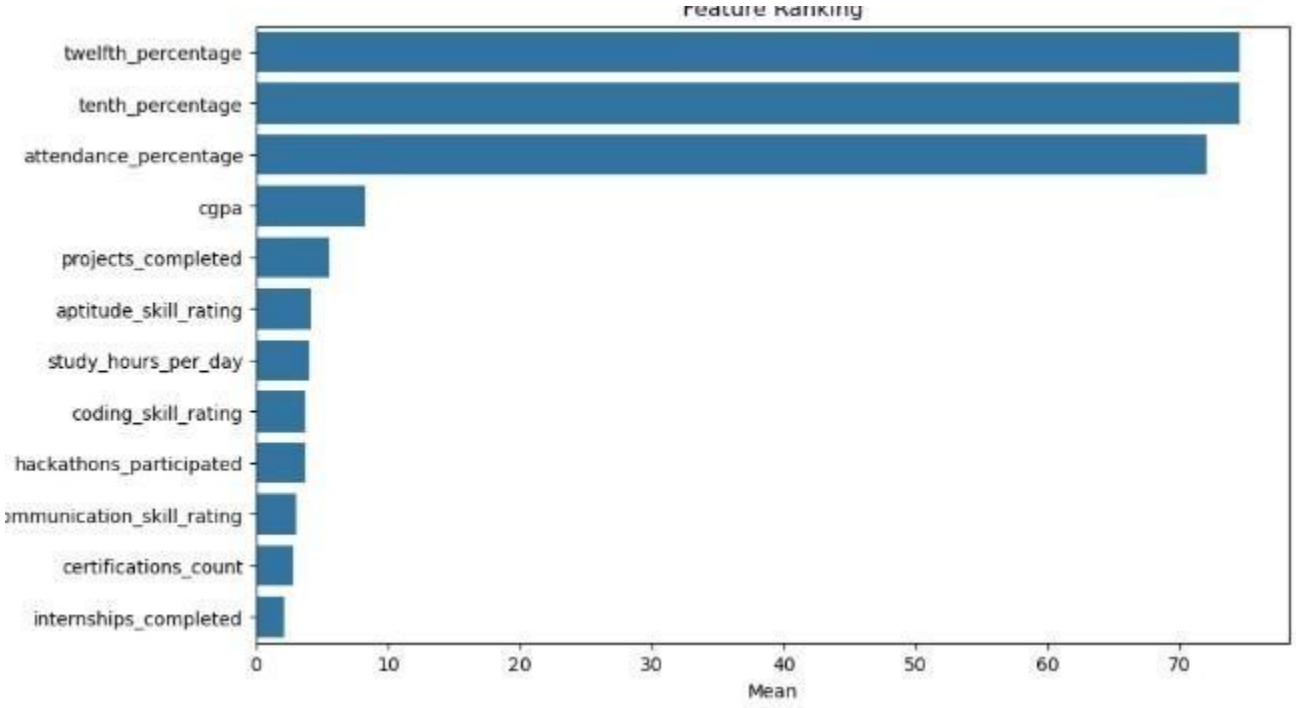
Train models by techniques such as Linear/ Logistic regression, Random forest, Decision trees.

Step 5: Evaluation

Use any one or more performance Analysis

DATASET ANALYSIS

The dataset includes 23 rows and 5000 columns.



The correlation heat map describe the how the all factors are contributing in the prediction. And how the factors are relatively gives values for prediction between o to 1.

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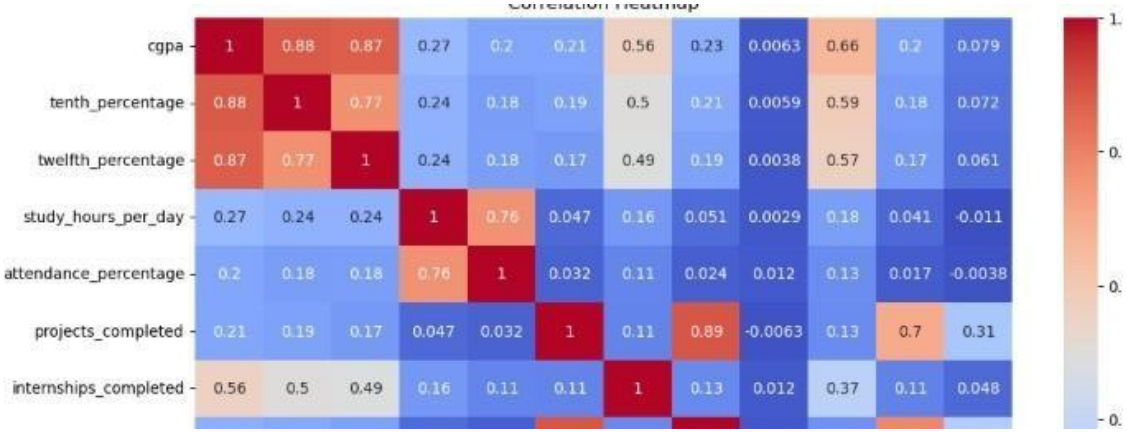
Comparative Analysis

The analytical skills includes cgpa,10th marks, 12th marks , attendance percentage

The technical skills include comunication skill rating, certifications count, projects, internships completed



Academic Performance includes

Academic Features Summary

	cgpa	tenth_percentage	twelfth_percentage	study_hours_per_day	\
count	5000.000000	5000.000000	5000.000000	5000.000000	
mean	8.283798	74.537400	74.543060	4.041120	
std	1.008391	10.266752	10.244481	1.967754	
min	5.000000	50.000000	50.000000	0.000000	
25%	7.610000	67.400000	67.600000	2.700000	
50%	8.320000	74.700000	74.800000	4.000000	
75%	9.020000	82.000000	81.700000	5.400000	
max	10.000000	100.000000	100.000000	10.000000	

	attendance_percentage
count	5000.000000
mean	72.041560
std	7.720029
min	44.700000
25%	66.600000
50%	72.050000
75%	77.200000
max	99.200000

The technical skills includes

Technical Skills Summary

	projects_completed	internships_completed	coding_skill_rating	\
count	5000.000000	5000.000000	5000.000000	
mean	5.529400	2.132600	3.728600	
std	2.053772	1.143713	1.278464	
min	0.000000	0.000000	1.000000	
25%	4.000000	1.000000	3.000000	
50%	6.000000	2.000000	4.000000	
75%	7.000000	3.000000	5.000000	
max	8.000000	4.000000	5.000000	

	communication_skill_rating	aptitude_skill_rating	\
count	5000.000000	5000.000000	
mean	3.025400	4.116400	
std	1.412358	0.716208	
min	1.000000	1.000000	
25%	2.000000	4.000000	
50%	3.000000	4.000000	
75%	4.000000	5.000000	
max	5.000000	5.000000	

	hackathons_participated	certifications_count
count	5000.000000	5000.000000
mean	3.704200	2.836000
std	1.603252	1.781724
min	0.000000	0.000000
25%	3.000000	2.000000
50%	4.000000	3.000000
75%	5.000000	4.000000
max	6.000000	9.000000

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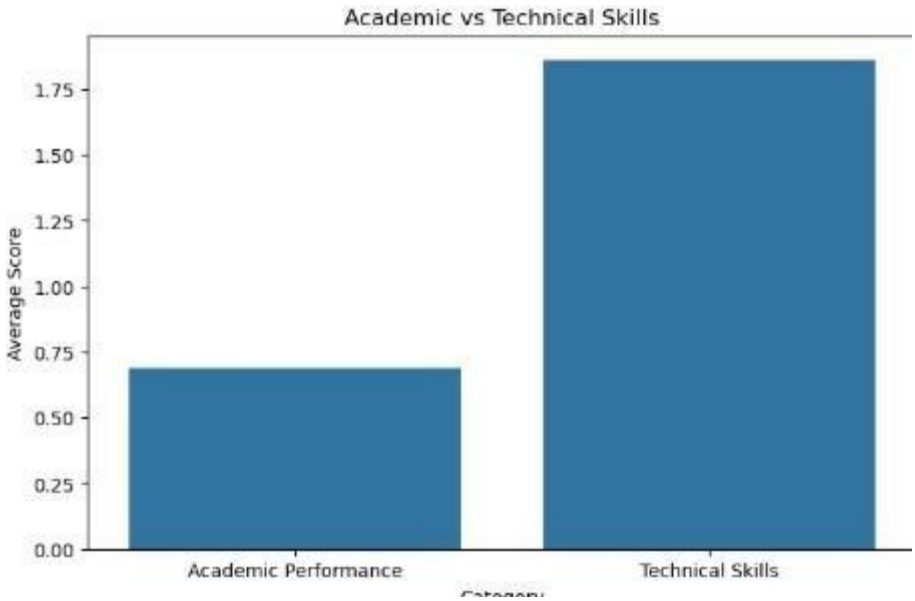
RESULTS:

Model	accuracy	Precision	recall	F1 score
Analytical skills	78.5%	76.2%	74.8%	75.5%
Technical skills	87.4%	86.3%	74.8%	75.5%
Overall results	92.8%	91.5%	93.2%	92.3%

Academic performance have a strong direct impact,



technical skills contribute to problem solving roles

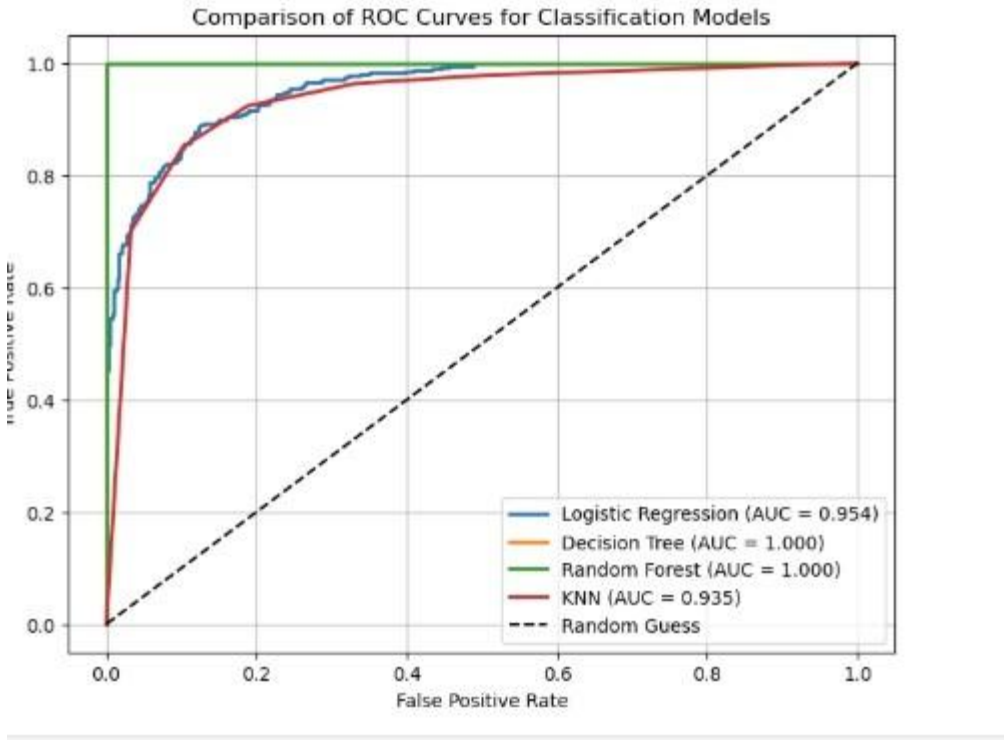
A combination both yields best prediction accuracy

MODEL EVALUATION

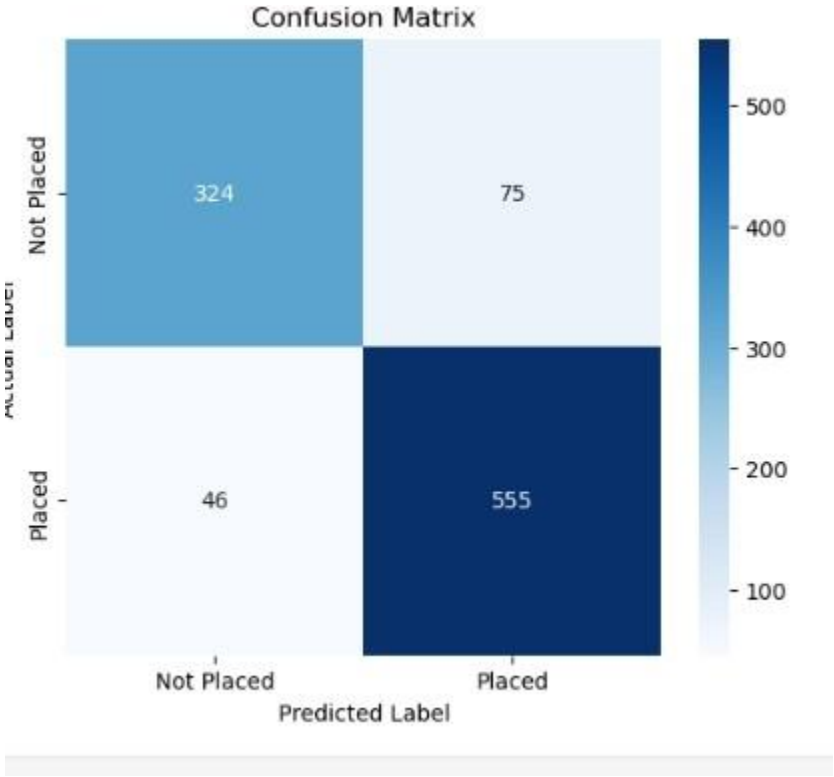
Based on the dataset we conclude that Decision trees and Random forest both are the best techniques to predict the prediction model but Random forest handle more number of features and attributes and to reduce overfitting

it is the best technique

	Model	Accuracy	Precision	Recall	F1 Score	AUC
1	Decision Tree	1.000	1.000000	1.000000	1.000000	1.000000
2	Random Forest	1.000	1.000000	1.000000	1.000000	1.000000
3	KNN	0.879	0.880952	0.923461	0.901706	0.935025
0	Logistic Regression	0.874	0.880000	0.915141	0.897227	0.954358



This is the ROC curve which shows Decision trees and Random forest gives maximum outputs and are more efficient



This is the confusion matrix which shows 20% of total students(1000) are tested out of which 555 students are placed and 324 are not placed.

FUTURE SCOPE

Artificial Neural Network may give more appropriate results.

Outcomes can be better by real time placement and interview performance data.

Expanding the dataset which include students from multiple universities.

Developing a web based placement prediction system for institutional use.

CONCULSION

This study is about comparative analysis of machine learning algorithm for predicting graduate placement. Multiple factors contribute to develop predicting model. The results highlight the importance of academic performance with technical skills which shows technical skills has slightly higher influence but analytical skills helped in employability and improve placement outcomes

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