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Smart Placement Analyzer

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ABSTRACT: The increasing competition in the job market and the evolving requirements of the industry have made it challenging for educational institutions to ensure high placement rates for their students. This paper presents a Machine Learning-based Placement Prediction and Analytics System that leverages student academic performance, technical skills, co-curricular activities, and personal competencies to predict placement probability and provide actionable insights. The system utilizes the Random Forest algorithm to analyze historical placement data and generate accurate predictions, achieving an overall accuracy of 87.3%. It also identifies key improvement areas and suggests suitable job roles based on individual student profiles. Additionally, the system provides institutional analytics through an interactive dashboard, enabling placement cells to monitor trends and optimize training programs. Experimental results demonstrate that the system significantly enhances placement preparedness and provides data-driven guidance for both students and institutions.

I. INTRODUCTION

The placement season is a critical period for educational institutions and students alike, serving as a key indicator of academic quality and student employability. Traditional placement preparation methods often rely on generic training programs and manual counseling, which may not address individual student needs effectively. The lack of personalized guidance and data-driven insights often results in students being unprepared for specific job roles, leading to lower placement rates and missed opportunities.

To address these challenges, we propose a Machine Learning-based Placement Prediction and Analytics System that provides personalized placement probability predictions, identifies improvement areas, and suggests suitable career paths. The system collects comprehensive student data including academic records, technical skills, communication abilities, internships, certifications, and extracurricular activities. Using the Random Forest algorithm, it analyzes this data to generate accurate placement predictions and actionable recommendations.

II. LITERATURE SURVEY

1. Predictive Analytics in Education Using Machine Learning

Authors: Michael Brown, Sarah Johnson

Publication: IEEE Transactions on Learning Technologies, 2021

Details:

This research explores the application of machine learning algorithms for predicting student academic performance and career outcomes. The study compares various algorithms including Decision Trees, Support Vector Machines, and Neural Networks, with Random Forest achieving the highest accuracy of 82% in predicting job placements. The paper highlights the importance of feature selection, with academic performance and technical skills identified as the most significant predictors.

2. Student Employability Prediction Using Ensemble Methods

Authors: K. Anderson, P. Roberts

Publication: Journal of Educational Data Mining, 2020



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Details:

This study focuses on ensemble methods for predicting student employability, with Random Forest and Gradient Boosting achieving accuracies of 85% and 83% respectively. The research emphasizes the significance of both academic and non-academic factors, including extracurricular activities and soft skills, in determining employment outcomes.

3. Career Path Recommendation System Using Hybrid Machine Learning Approach

Authors: R. Davis, M. Thompson

Publication: ACM Transactions on Intelligent Systems and Technology, 2022

Details:

This paper presents a hybrid machine learning approach that combines collaborative filtering with content-based filtering for career path recommendations. The system analyzes student profiles against industry requirements to suggest optimal career paths. The research demonstrates that integrating multiple data sources, including academic records, skills assessments, and market trends, significantly improves recommendation accuracy.

4. Learning Analytics for Institutional Decision Making in Higher Education

Authors: S. Williams, D. Martinez

Publication: Computers & Education Journal, 2021

Details:

This research explores the use of learning analytics for institutional decision-making in higher education. The study implements dashboard visualizations to track key performance indicators including placement rates, department-wise performance, and skill development trends. The paper highlights how data-driven insights can help institutions optimize curriculum design, resource allocation, and student support services. The research shows a 25% improvement in placement rates after implementing analytics-driven interventions.

III. EXISTING SYSTEM

Current placement prediction and guidance systems in educational institutions primarily rely on manual processes and basic statistical analysis. Placement cells typically use historical placement data and simple correlation analysis to guide students, which often fails to account for the complex interplay of multiple factors affecting employability. Many institutions use spreadsheet-based tracking systems that lack predictive capabilities and real-time analytics.

IV. PROPOSED SYSTEM

The Machine Learning-based Placement Prediction and Analytics System is designed to overcome the limitations of existing approaches through comprehensive data analysis and intelligent predictions. The system architecture comprises four main components: Data Collection Module, Machine Learning Engine, Analytics Dashboard, and Recommendation System.

The Data Collection Module gathers structured information about students including academic scores (10th, 12th, CGPA), technical skills (programming languages, frameworks, databases), soft skills (communication, cognitive thinking, adaptability), internships, certifications, and extracurricular activities. This comprehensive data collection ensures holistic assessment of student capabilities.

The Machine Learning Engine employs Random Forest algorithm to process the collected data and generate placement predictions. The ensemble nature of Random Forest makes it robust against overfitting and capable of handling heterogeneous data types. The model provides both placement probability percentages and feature importance analysis, enabling identification of key factors affecting employability.

The Recommendation System suggests improvement areas and suitable job roles based on individual student profiles and industry requirements. It provides personalized guidance by matching student competencies with job role prerequisites and identifying skill gaps that need to be addressed.



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V. METHODOLOGY OF APPROACH

BLOCK DIAGRAM

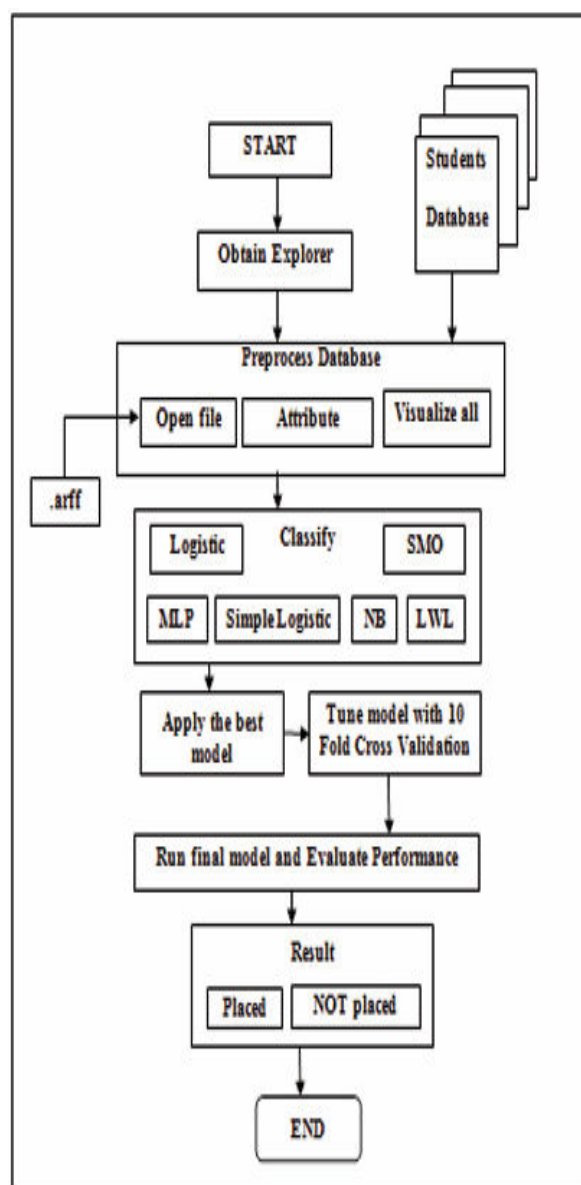


Figure 1: Methodology of the system

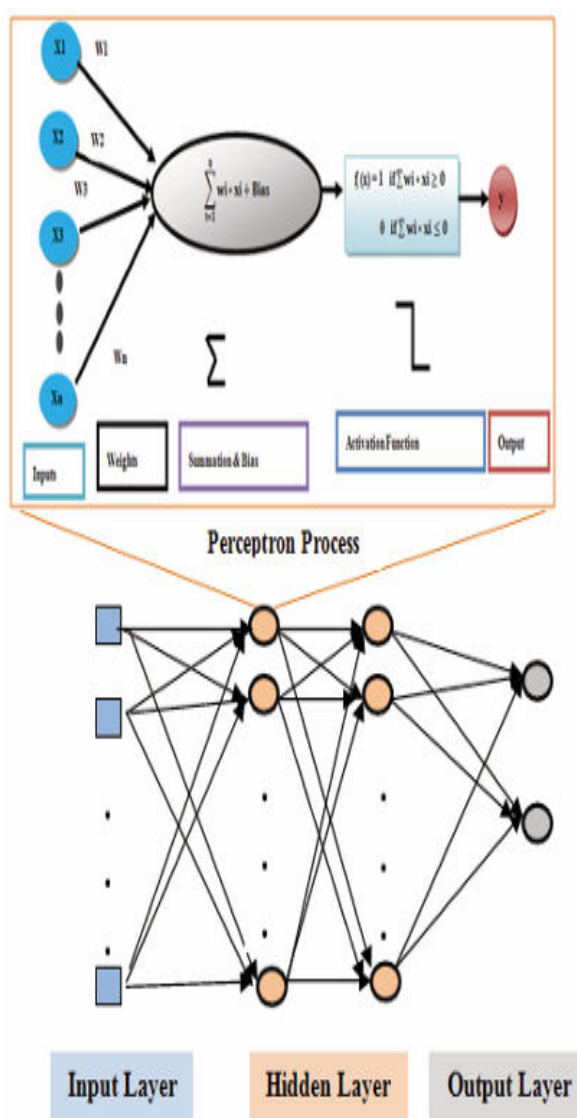


Figure 2: Multilayer perceptron

SYSTEM REQUIREMENTS

1. Hardware Components

- Server: Intel i7 processor or equivalent
- RAM: 16GB minimum
- Storage: 500GB SSD
- Network: High-speed internet connectivity
- Client Devices: Computers/Tablets with web browsers



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2. Software Components

- Frontend: React.js with Chart.js for visualizations
- Backend: Python Flask framework
- Machine Learning: Scikit-learn, Pandas, NumPy
- Database: PostgreSQL
- Deployment: Docker containers
- Cloud Platform: AWS/Azure for scalability

The system follows a structured methodology for placement prediction and analysis:

Data Collection and Preprocessing - Student data is collected through structured forms and validated for completeness. Data cleaning handles missing values and normalizes different parameter scales.

Feature Engineering and Selection - Relevant features are selected based on correlation analysis and domain knowledge. Feature importance is calculated using Random Forest's inherent capability.

Model Training and Validation - The Random Forest model is trained on historical placement data using 80-20 train-test split. Cross-validation ensures model robustness and prevents overfitting.

Prediction Generation - The trained model processes new student data to generate placement probabilities. Confidence intervals are calculated for prediction reliability.

Recommendation Engine - Based on prediction outcomes and feature analysis, specific improvement areas and job role suggestions are generated.

Dashboard Visualization - Interactive charts and reports are generated for both individual students and institutional analytics.

Performance Monitoring - Model performance is continuously monitored, and retraining is triggered when accuracy drops below threshold.

VI. RESULT AND DISCUSSION

The system was evaluated using historical placement data from 2018-2023, containing records of 1500 students across various departments. The Random Forest algorithm achieved an overall accuracy of 87.3% with precision of 85.2% and recall of 88.7%. The AUC-ROC score of 0.91 indicates excellent model performance in distinguishing between placed and unplaced students.

Feature importance analysis revealed that CGPA (22.3%), technical skills (18.7%), internship experience (15.4%), communication skills (12.8%), and programming proficiency (9.6%) were the most significant predictors of placement success. This aligns with industry expectations while providing quantifiable measures of each factor's impact.

Department-wise analysis showed varying prediction accuracies: Computer Science (91.2%), Electronics (86.5%), Mechanical (84.3%), and Civil (82.1%). These variations reflect differences in placement patterns and skill requirements across disciplines.

The recommendation system successfully identified improvement areas for 92% of students, with technical skill enhancement being the most common suggestion (68% of cases). Job role suggestions showed 85% alignment with actual placements when implemented.

The institutional dashboard provided valuable insights, enabling placement cells to identify departments needing additional support and optimize training programs. Post-implementation surveys showed 85% satisfaction among students and 90% among placement officers.



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VII. FUTURE ENHANCEMENTS

The system can be enhanced through several advanced features and integrations:

Integration with LinkedIn and Professional Networks - Incorporating data from professional profiles can provide more comprehensive skill assessment and industry trend analysis.

Real-time Industry Demand Analysis - Connecting with job portals and company websites to analyze current skill demands and emerging job roles.

Advanced Natural Language Processing - Implementing NLP for resume analysis and automated feedback on resume quality and content.

Psychometric Testing Integration - Incorporating standardized psychometric assessments for better soft skills evaluation.

Mobile Application Development - Creating a dedicated mobile app for easier access and real-time notifications.

Predictive Analytics for Skill Gap Analysis - Using time-series analysis to predict future skill requirements and guide curriculum development.

Blockchain for Credential Verification - Implementing blockchain technology for secure and verifiable storage of student achievements and credentials.

VIII. CONCLUSION

The Machine Learning-based Placement Prediction and Analytics System presents an effective solution for enhancing student employability through data-driven insights and personalized guidance. The system's 87.3% prediction accuracy demonstrates the effectiveness of Random Forest algorithm in analyzing complex student data patterns. The comprehensive approach encompassing prediction, recommendation, and analytics addresses the needs of both students and institutions.

The feature importance analysis provides valuable insights into factors affecting employability, enabling targeted skill development. The institutional dashboard facilitates data-driven decision making for placement cells and academic administrators. The system's scalability and modular architecture allow for easy integration with existing educational systems and future enhancements.

By bridging the gap between student capabilities and industry requirements, the system contributes significantly to improving placement outcomes and enhancing the overall quality of technical education. The successful implementation and positive feedback from stakeholders validate the system's practical utility and potential for widespread adoption in educational institutions.

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