Job Success Prediction: An Exploration of Machine Learning and Deep Learning in Bangladesh

BY

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The Degree of Masters of Science in Computer Science and Engineering

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APPROVAL

This Thesis titled **"Job Success Prediction: An Exploration of Machine Learning and Deep Learning in Bangladesh"**, submitted by **Hafizur Rahman**, ID No: **232-25-033** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **11-01-2025**.

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I hereby declare that this research has been done by me under the supervision of **Abdus Sattar, Assistant Professor, Department of CSE,** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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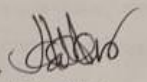

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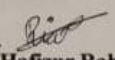

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ABSTRACT

Unemployment is one of the critical challenges in Bangladesh, with an approximate unemployment rate of 4.20%. However, over the past year, more than 8 lakh graduates from public and private universities entered the job market. This research exposes the machine learning and deep learning algorithms to address issues related to job success rate. By employing ensembled learning-based algorithms the study achieves an impressive accuracy rate of 95% that significantly outperforms traditional methods. This methodology aims to help employers to identify their ideal employees and attract candidates who can be a good fit for the industry. Therefore, we aspire to help institutions in redesigning their curriculum that will help students to prepare for the market needs. This research holds immense significance for the country, not only by addressing the employment gap but also by enhancing the overall job market. Through the development of computational methods, the study aims to improve the unemployment crisis by addressing problems like shortage of skill, while accelerating the socioeconomic aspect of the country. The integration of predictive analysis within the hiring process will benefit both companies and colleges in the study-to-work transition. Moreover, deploying such system in Bangladesh has great potential to overcome social and economic challenges, paving the way for a more prosperous and stable future.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Unemployment is a huge issue in Bangladesh. According to the central bank, it came down to 4.20% of the total workforce by 2023. More than 800,000 graduates come into the job market every year from public and private universities, making the competition with each other even higher. However, these traditional methods of recruitment in the country have by and large failed in finding the right candidate suitability for jobs in organizations, as most often applicants' qualifications mismatch the job requirements. These methods typically depend on limited selection criteria like academic qualification, which is hardly predictive to forecast long-term job success. Consequently, it remains difficult to determine the extent to which graduates feel prepared for the workforce.

This proposed methodology has considerable benefits on both the employer and the educational institution's side. It will save employers time in the recruitment process since candidates will have already achieved more than the required industrial standards. The educational institution will also learn from the study in terms of curriculum development, so as to produce graduates with skills to meet the demands of the job market. This will surely promote a better linkage between education and employment, thus easing the problem of skill mismatch and enhancing graduate employability.

Furthermore, this research depicts the potential of predictive analytics in bringing down unemployment rates and improving the socio-economic condition to an extent in Bangladesh. The increased productivity with the addressal of the skill gap in the workforce through this study and economic growth has been possible through various applications of ML and DL techniques. This research is expected to set an example in defining innovative approaches to recruitment that would deal with bigger social challenges and create a more stable and prosperous future.

1.2 Motivation

The motivation for this research is compounded by the limited research on graduates' preparedness for employment and the growing demand for an in-depth study to address industry requirements. The current graduate unemployment trends call for urgent research that will reflect on the required tools of employability assessment to be used by both the graduate and the employer. There is a gap between what graduates possess and what employers expect of them in terms of skills, especially in areas such as English proficiency, communication, and the overall attitude towards professionalism [3].

1.3 Rationale of the Study

The rationale behind this study is that early research focused on factors determining job success and pinpointed employability skills, such as communication, problem-solving, and teamwork, in making the graduate more marketable. Yet, notwithstanding some curricular reforms and employability skill development initiatives, job success remains tough to predict because requirements certainly vary across disciplines. The recent advancement in data mining has opened the door for modeling employability prediction by considering factors like academic performance, internship experience, and personal attributes [4].

While machine learning and deep learning create new horizons for this transformation of recruitment practices, enabling one to make more profound analyses of candidates rather than just mere qualifications, several challenges persist in the development of such systems. These include the creation of models which will, in reality, estimate the potential of candidates to be successful in the long run. The research gap this study attempts to fill is through an ensemble learning algorithm capable of predicting job success with a higher rate of accuracy at 95%, higher than earlier methods' efficiency.

1.4 Research Questions

- RQ1: How can the integration of AI to predict job success utilizing Bangladeshi perspective?

- RQ2: What are the key factors discovered by this study, that contribute to job success?
- RQ3: How does the accuracy of proposed ensemble model ensures the proposed system's reliability compared to traditional recruitment methods?

1.5 Expected Output

- Development of a robust ensemble model for accurate prediction of job success rate.
- A comprehensive insight into key factors to consider while ensuring the employability.
- A reliable and effective tool for job seekers to predict their potentiality and changes of success based on their qualification.
- A bridge between educational institutions and job market to address the skills gaps generally found in fresh graduates.

1.6 Project Management and Finance

This research work has not received any funding from any individuals or organization.

1.7 Report Layout

Chapter 1 outlines this study's objectives and the primary research questions. Chapter 2 offers a brief overview of the relevant literature. In Chapter 3, the research methodology is thoroughly explained. Chapter 4 presents and analyzes the experimental results of the study. Chapter 5 explores the sustainability plan, the societal and environmental implications, and the ethical considerations associated with the research. Finally, Chapter 6 summarizes the findings and suggests directions for future work.

CHAPTER 2
BACKGROUND

2.1 Preliminaries/Terminologies

The methodological implications of this study include several key terms regarding the job success prediction. This fosters the likelihood of excelling in a job role for a candidate based on their qualifications and experiences. In this research, various models such as Artificial Neural Networks (ANN), Naive Bayes, Gradient Boosting Machines (GBM), and Logistic Regression were applied to predict job success. Data Preprocessing involves cleaning and transforming raw data into a format suitable for analysis, including normalization, encoding, and handling missing values. Exploratory Data Analysis is used to identify patterns, correlations, and influential features that contribute to successful job outcomes.

2.2 Related Works

The report clearly points out the fact that currently there is still no clear solution to the unemployment among autistic persons in the community despite much research that have indicated some of the obstacles to and the catalysts of this unemployment. Incontestably, the research proves that the trees of decision could be employed as the preparatory tactics intended to highlight the features which a crucial impact on occupational selection at last to be the base for the reactive interventions used [3].

A Bayesian naïve classifier, support vector machine, and the mentioned model of machine learning are tools that are used currently to predict candidate job employment status. This entails easy automation of hiring processes and applicant analysis. SVM was more accurate than the other two techniques with an accuracy level of 93%, nonetheless, the tuning of parameters by 93% and 91% respectively in the case of RF and NB enabled them to stand at the top [4].

Many researchers examine why some students struggle with employment after graduating. They use six key approaches, especially at scientific institutions. A study highlighted data collection procedures, not just explaining vulnerability and critiquing health information processes but also analyzing the full data-gathering methodology [5]. Data mining is applied to determine the employability of UKM alumni. J48 proved superior over MLP, SOM techniques, hitting a 66.18% accuracy level. It showed age, faculty affiliation, degree program domain, and English proficiency as key factors impacting job prospects. Machine learning can forecast students' future jobs with great accuracy. Ensemble learning models are best at this [6]. That boosts schooling quality, so it's a cool concept. However, some sentences can be short. Others, longer and more complex, would match human speaking patterns better. While maintaining appropriate word usage for grade 7-8 comprehension levels [7].

Students' jobs are analyzed using ratings. The most crucial rating was tenth-grade scores. Next, we are twelfth-grade and engineering course issues. Decision trees predicted job placements by comparing predictions. Stochastic Gradient Descent was best at 0.9117. Academic skill data might improve predictions rate [8]. Artificial intelligence examines image data well. Rising image field interest suggests leadership opportunities may come [9]. The study uses automated machine learning to make better guesses about students doing well in school. It got 75.9% right. The Ensemble Model guessed failing students right 83% of the time. This shows we need complex math methods and a good balance of data and personal information about students [10]. Student performance is an important topic in schools. Machine learning can help predict how students will do. It can spot struggling students early on. This allows giving them extra help to improve their test scores. Taking final exams is also easier with more time. However, things outside school like money and feelings matter too [11]. Using EDM ways, this work sets rules for foretelling student programs early, aimed at college and grad students. A six-step outline covers design, putting into practice, and top methods. It pushes teachers and non-tech folks to use EDM for undergrads [12]. Rehumanizing education is key to growth in Bangladesh. Universities help the economy grow. They open doors for small businesses. From 2016 to

2030, the government wants strong universities. But some issues remain. Reforms are needed. New policies in research can unlock more growth [13].

Many students from religious schools face trouble getting work. They experience unfair treatment and have limited job options. Their skills are not valued enough by employers. Religious schools need better lessons to prepare kids for jobs. Technical training should be added to lessons. School systems need an upgrade through reforms. The government should pay more money to improve religious education. With changes, students will find suitable jobs easier [14].

Many university graduates in Bangladesh struggle to get jobs. But employers need skilled workers. Universities offer the right courses. Still, some employers feel there is a gap. Graduates may lack the skills employers want [15]. Many students in Bangladesh go to Islamic schools. However, these students often stop learning after finishing school. They feel unhappy about their education. The researchers say these schools need to teach more English, math, and computer skills [16]. Typically, the managers of the companies in Bangladesh used to employ their relatives or their known persons. Nowadays, professional networks have become a more updated and trusted way to search for employable graduates. Universities may apply curriculum, teaching methods, community service, cooperative training, and internship programs to smooth the way from classroom to workforce [17].

Because of this, Bangladeshi graduates of an educated class from lower- and middle have an interest in entrepreneurship and they are targeting government jobs. In this way, they are falling prey to devotional issues, humiliation, socio-economic challenges, and loss of personality [18]. Management problems exist in public universities where undisciplined students do political feuds and student politics along with poor performance of their managers that results in an ineffective framework for the whole university. Whilst civil society associations- private universities- started, in 1992, to be the slightest acceptable deflection from the dominant government from the late 1980s, they care about offering global quality but still lack infrastructural development. Arguments usually come around the issues of openness, accountability, and matching yardstick of private universities'

effectiveness [19]. A study showed the number of science enrollment in Natural Sciences and Business Administration increased from 2001/2 to 2017. In comparison, the number of students interested in Business Administration showed a low rise during the same period. Nevertheless, some researchers however indicate some students opt out of Natural Sciences, especially in Physics [20].

The rising standard of living, the labor decisions, and the cultural norms that are given as a result of colonialism share in the destruction of the last colonial remnants and even encourage the poorest and those who work in the agricultural fields to the better. The economic factors prevailing after giving up the BESTCAP Policy from the Bangladesh Labor Bureau stats are going to be discussed as the prime factor of the research [21]-[24].

In the course of the investigation, the four types of classifiers Naive Bayes, J48, Bagging, and Random Forest were to be employed. Due to the higher accuracy of 67.40332 percent, Random Forest was used and the error was only 0.00377 percent [25].

In the years up to 2040, the amount of AI technology-enabled changes will be tripled in the apparel and textile industries. The policy of making people re-skill themselves, together with education-employment links and financial assistance will help people cope with this rapidly changing environment [26]-[27]. The logistic regression shows a better prediction performance of the students according to the recent study, the accuracy reaches 81.52% and the specificity (Sensitivity) achieves 91.44%. Regarding the industrial area, ANN-5 is now the most effective technic used to work out. A predictive model has 74.1 percent accuracy about the coming senior high school strand choice which means that the AI-driven method can successfully predict the pathway of academic life and supports its policy recommendation on this basis [28]-[31]. The system we suggest melts the state of the art technologies such as the systems of artificial neural networks to increase accuracy and precision of the predictions of student graduation time. By using comprehensive system that unites cognitive and non-cognitive indicators, as well as background factors, the system gives a more accurate and integrated perspective for understanding and predicting trajectories in academic success. By means of using simulated datasets the assessment

conducts by itself to see what the system stands for and the process performance is higher in accuracy and low error rates. However, the commencement of the systems with the viable data brings a possibility of supplying the students not only the pathway but also the academic susceptibility wherever there are the education campuses. In general, however, these unique solutions have good prospect to influence students' learning, yet, they play a part in the strategic decision-making and planning of educational institutions [32]-[33].

2.3 The Problem's Scope

This study primarily focused on addressing the most alarming issue of Bangladesh regarding the unemployment. Targeting over 80,000 graduates who are preparing for entering corporate world, this study presents a significant advancement in the recruitment process by predicting job success. While relying mostly on long term job experience and academic excellence, the job sectors often overlook the talented experts with high potentiality. This study addresses this issue by making it a scope to develop a predictive model that will enhance the recruitment processes, improving graduate employability, and addressing the skill gap in the workforce.

2.4 Challenges

While implementing this system, we faced several challenged. Firstly, a dataset is a key to make an efficient predictive model, so enduring a high-quality dataset with high volume was a challenge. However, we managed to get a very large volume data with 85,000 instances further boost out motivation for the study. Secondly, when we use large dataset, it is very hard to achieve a good accuracy as there are the potentiality of redundancy and dissimilarity in data patterns as they are collected from diverse sources, overall affects the model's training process. To ensure the model's robustness we had to delve into several ML and DL approaches as well as explore ensemble models. Finally, maintaining the model's relevance and accuracy over time is a significant challenge, as workforce dynamics and job market trends continuously evolve.

CHAPTER 3
RESEARCH METHOLOGY

3.1 Proposed Methodology

We proposed an advanced job success prediction model utilizing both Machine Learning (ML) and Deep Learning (DL) algorithms. This approach involves a systematic process that includes data collection, pre-processing, feature engineering, model selection, training, evaluation, hyperparameter tuning, implementation, and maintenance. The full procedure is presented in Figure 1. To achieve a robust prediction model, we explored a range of algorithms suitable for classification tasks, including Artificial Neural Networks (ANN), Naive Bayes, Gradient Boosting Machines (GBM), Logistic Regression, and AdaBoost. Ensemble learning techniques such as bagging, boosting, and stacking were also incorporated to enhance model performance.

Exploratory Data Analysis (EDA) was conducted to identify the most influential features contributing to job success. Correlation analysis and feature importance ranking techniques were applied to uncover relationships between the attributes and job success. These methods helped priorities features such as educational background, job experience, and technical skills. In some cases, new features were engineered by combining existing attributes or deriving new insights from the data. For example, we introduced a feature representing the combination of educational level and technical skill, which provided valuable information on an individual's qualifications.

To evaluate the model, we employed several performance metrics, including accuracy, precision, recall, F1-score, and ROC-AUC. Accuracy provided an overall measure of model performance, while precision and recall offered more detailed insights into how well the model distinguished between successful and unsuccessful job outcomes. The F1-score, being the harmonic mean of precision and recall, was particularly useful in scenarios with imbalanced datasets. ROC-AUC was used to assess the model's ability to differentiate

between positive and negative classes across different thresholds, offering a comprehensive measure of classification performance.

To ensure the model's robustness and generalizability, cross-validation techniques were employed. Specifically, K-fold cross-validation was used to split the data into several subsets, allowing the model to be trained and tested on different segments of the dataset. This approach helped identify any potential overfitting or underfitting issues, ensuring that the final model was capable of generalizing to new, unseen data. Cross-validation also provided a more reliable estimate of the model's performance, particularly in real-world scenarios where new data may differ from the training set.

Once the final model was selected, it was implemented and deployed for practical use. The implementation process involved integrating the model into a user-friendly interface that could be used by organizations or job seekers to predict job success. This interface was designed to be intuitive, allowing users to input relevant information such as their educational background, technical skills, and job experience. The model would then predict the likelihood of success in specific job roles, providing valuable insights for both job seekers and employers. Maintenance of the system was also considered, allowing for updates to the model as new data becomes available. Regular updates will ensure that the model continues to perform effectively as job market trends evolve.

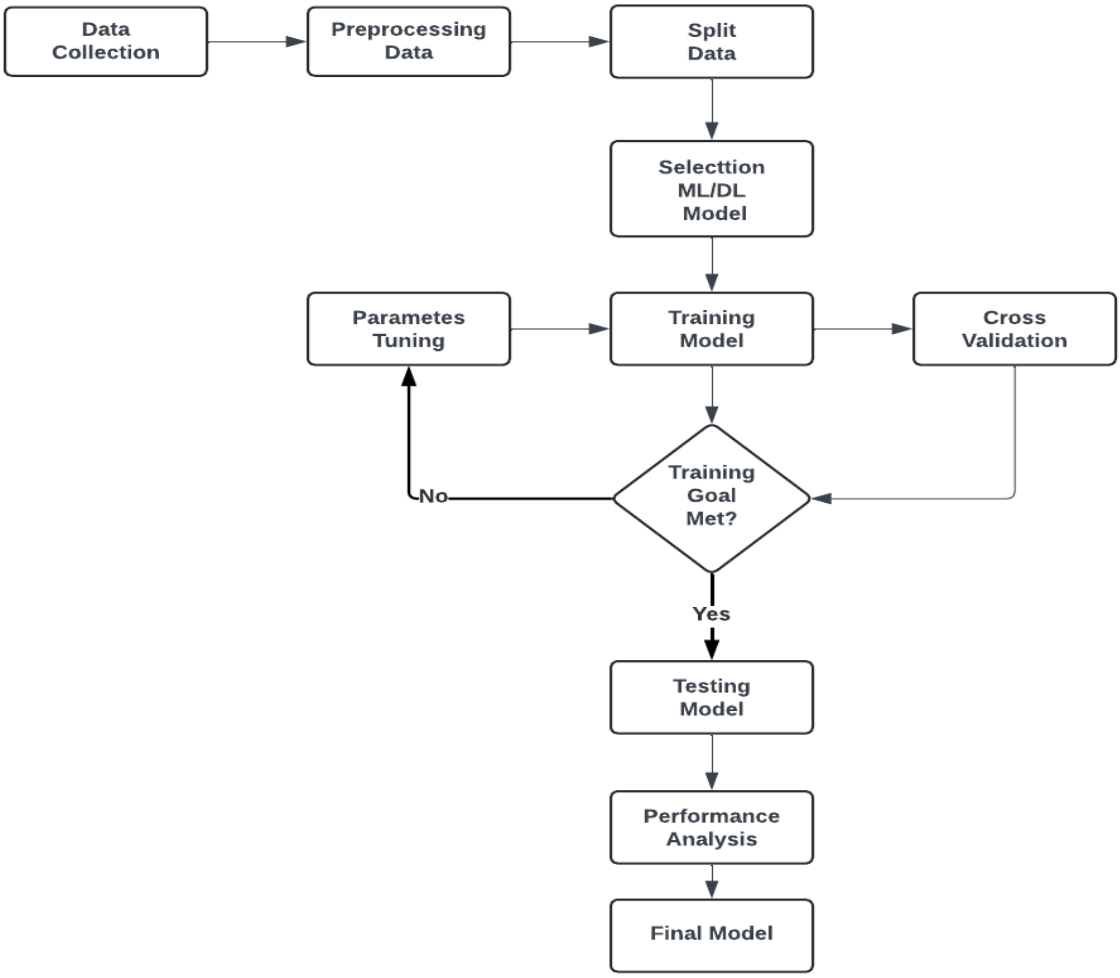

Figure 1: Work progress of the study

3.2 Dataset Utilized

The dataset comprised 85,000 records, incorporating attributes like gender, age, education, technical and soft skills, academic performance, and previous work experience. Table 1 presents a summary of the key attributes used in this study. For instance, 'Person ID' refers to the unique identification number of each user, while attributes such as 'Bach. Org' and 'Masters' indicate whether an individual completed their Bachelor's or Master's degree in a public or private institution.

Table 1: Attribute name and Summary

Attribute Name	Summary
Person ID	Registered user's unique identification number
Name	User's Name
Age	User's Age
Gender	User's Gender
Bach. Org	Organization is classified as either public or private. Public: 1 and Private: 0
Bach. Subject	Pursuing a Bachelor Degree is a significant goal for many individuals.
Masters	The Job seeker achieved a postgraduate degree or not
Masters Edu Organization	Organization is classified as either public or private. Public: 1 and Private: 0
Masters Subject	The subject is pursuing a Master's Degree.
Tech Skill	User's having technical skill or not
Soft Skill	User's having technical skill or not
Education Result	Scoring over CGPA 2.25 or not; Over CGPA 2.25:1, Less than CGPA 2.25: 0
Video CV	The Job seeker had video CV or not
Experienced	The Job seeker had job experience

3.3 Data Pre-Processing

After data collection, the full pre-processing steps can be seen in Figure 1, which includes addressing inconsistencies, outliers, and correcting any mislabeling. Numerical features were normalized to ensure uniform scaling, while categorical attributes were transformed using either one-hot encoding or label encoding, depending on the context. These steps were critical to ensuring the dataset was suitable for training and testing, minimizing potential noise and irrelevant data.

3.4 Proposed Model

In the model selection phase, we evaluated various ML and DL algorithms. Logistic Regression and Naive Bayes were initially considered for their simplicity and interpretability, providing baseline comparisons. More advanced models, such as Gradient Boosting Machines (GBM), AdaBoost, and Artificial Neural Networks (ANN), were later employed to improve accuracy and capture more complex patterns in the data. GBM and AdaBoost are ensemble methods known for their ability to reduce bias and variance by combining the predictions of multiple weak learners, while ANN was employed for its capacity to model non-linear relationships and capture high-level abstractions in the data.

The dataset was divided into training, validation, and test sets using an 80/10/10 split, allowing for sufficient training while ensuring a separate validation set for tuning and a test set for final evaluation. Grid search and random search techniques were employed to optimize hyperparameters. For GBM and AdaBoost, hyperparameters such as learning rate, maximum depth, and the number of trees were adjusted. For ANN, the architecture was fine-tuned by varying the number of hidden layers, neurons per layer, and activation functions. The goal was to balance model complexity and computational efficiency, ensuring optimal performance without overfitting.

Ensemble learning techniques were integrated to further improve model performance. Bagging was used to reduce variance by training multiple instances of the same model on different subsets of the data. Boosting, which aims to reduce bias, involved training models sequentially, where each new model corrected the errors of its predecessor. Stacking was also explored as a method to combine the strengths of different models by training a meta-model on the predictions of base models. These ensemble methods enhanced the robustness and accuracy of the job success prediction model.

3.4.1 Gradient Boosting Machines

GBM are ensemble learning models that sequentially train a series of weak learners, usually decision trees, to minimize errors and improve overall model performance. Each

subsequent tree is trained on the residual errors of its predecessor, ensuring the model focuses on difficult-to-predict samples. GBM employs gradient descent to optimize the loss function, which can be adapted to various problems, such as regression or classification.

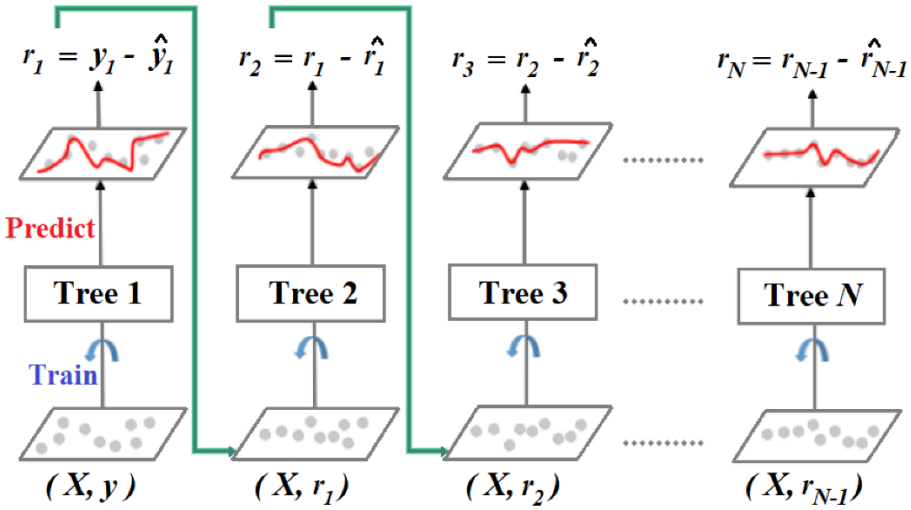

Figure 2: Model architecture of Gradient Boosting

Hyperparameter tuning, including adjustments to learning rate, maximum tree depth, and the number of estimators, was critical to achieving high performance. GBM's capability to handle heterogeneous data types and capture complex feature interactions made it a valuable model in this study.

3.4.2 AdaBoost

AdaBoost, or Adaptive Boosting, constructs a strong classifier by sequentially combining weak classifiers, typically decision stumps. Unlike GBM, AdaBoost assigns higher weights to misclassified samples, compelling subsequent classifiers to prioritize these challenging cases. The algorithm continues until the desired accuracy or a predefined number of estimators is achieved. Key hyperparameters such as the learning rate and the number of estimators were optimized to enhance performance. AdaBoost's strength lies in its ability

to reduce both bias and variance, making it an effective choice for moderately complex datasets.

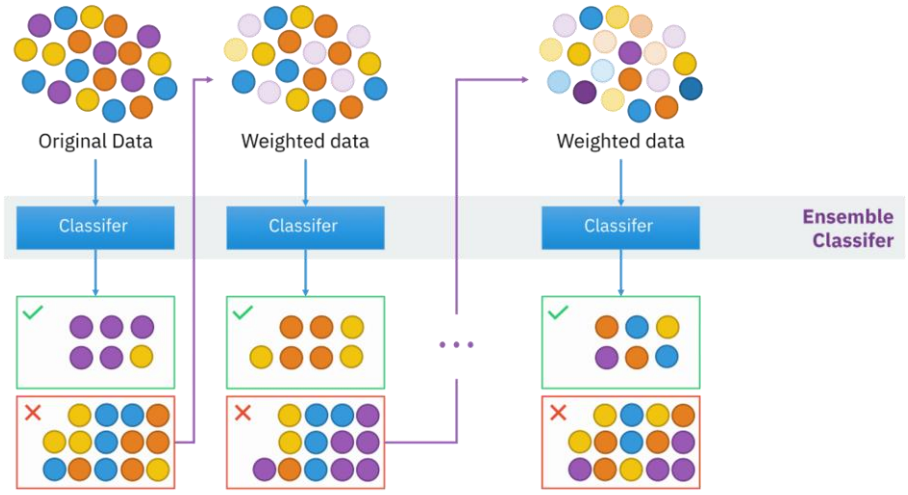

Figure 3: Model architecture of AdaBoost

3.4.3 Logistic Regression

Logistic Regression is a simple yet effective baseline model for binary classification tasks. It assumes a linear relationship between the input features and the log-odds of the target variable. The model uses the sigmoid function to map predictions to probabilities. Logistic Regression is interpretable and computationally efficient, providing valuable insights into feature importance. Despite its limitations in capturing non-linear relationships, it served as a baseline to compare against more complex models in this study.

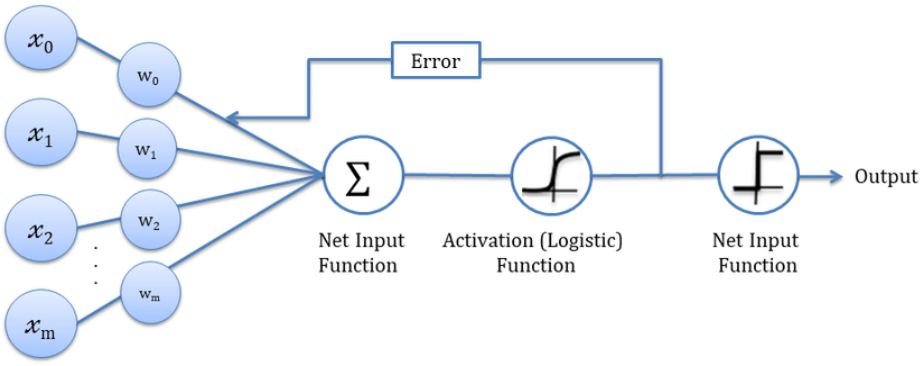

Figure 4: Model architecture of Logistic Regression

3.4.4 Naive Bayes

Naive Bayes is a probabilistic classifier based on Bayes' theorem, assuming independence among features. While this assumption rarely holds in real-world datasets, Naive Bayes often performs well in text classification and spam detection due to its simplicity and speed. The model's hyperparameters, such as the smoothing parameter, were tuned to optimize performance. Naive Bayes provided a useful benchmark for evaluating more advanced algorithms.

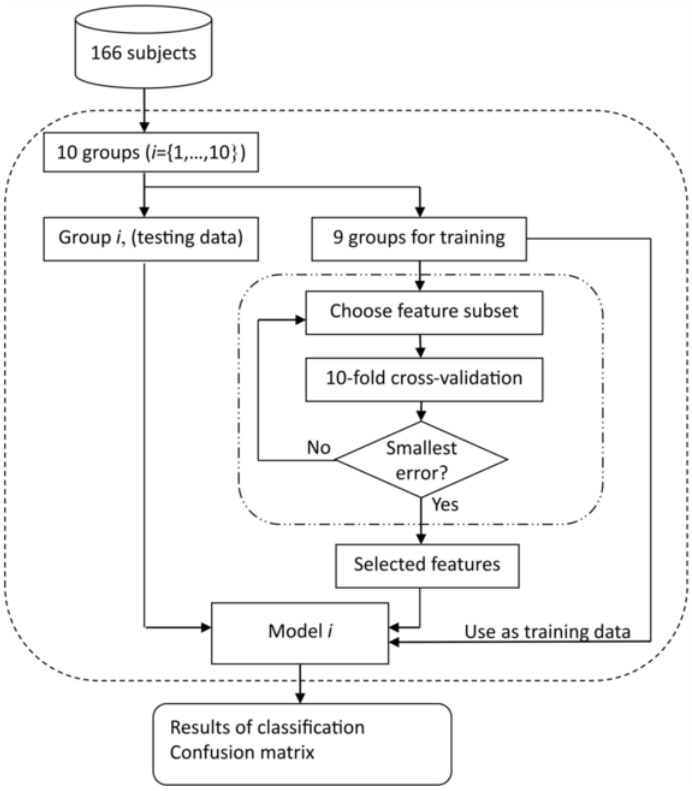

Figure 5: Model architecture of Naive Bayes

3.4.5 Artificial Neural Networks

ANN are powerful models inspired by the human brain, capable of learning complex, non-linear relationships from data. ANN consists of multiple layers: an input layer, one or more hidden layers, and an output layer. Each layer contains interconnected nodes (neurons) that process inputs using weighted sums and activation functions ReLU.

In this study, extensive experimentation was conducted to design an optimal ANN architecture. Variations in the number of hidden layers (ranging from 2 to 5), the number of neurons per layer (50 to 200), and activation functions were explored to find the best configuration. Dropout layers were added to mitigate overfitting, while batch normalization improved training stability and convergence speed. The ANN model was trained using the Adam optimizer with a learning rate fine-tuned through grid search. Regularization techniques, such as L2 regularization, were applied to enhance generalization.

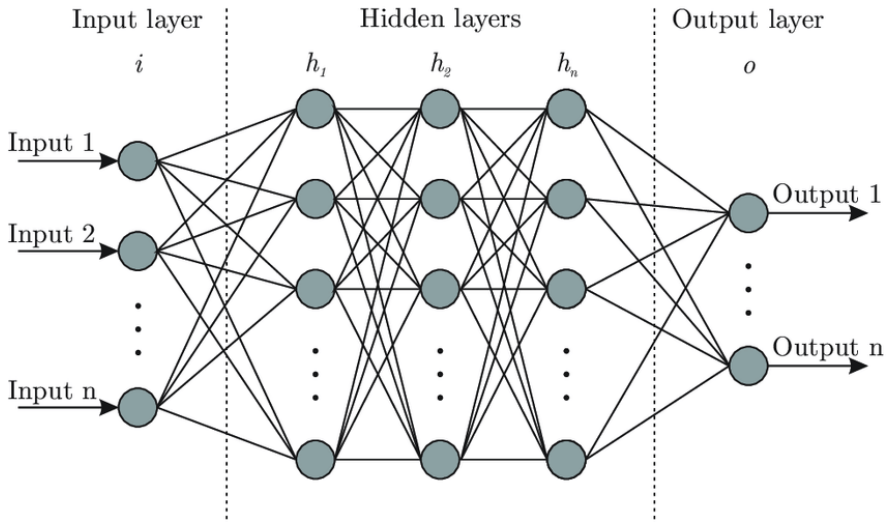

Figure 6: Model architecture of ANN

The ANN outperformed traditional ML models due to its ability to capture high-level abstractions and interactions in the data. Its flexibility made it a cornerstone of this study's modeling approach.

3.4.6 Bagging

Bagging, or Bootstrap Aggregating, is an ensemble technique designed to reduce variance by training multiple instances of the same model on different bootstrapped subsets of the data. These models' predictions are aggregated, typically through averaging (for regression) or voting (for classification). Bagging enhances stability and accuracy, particularly for high-variance models such as decision trees.

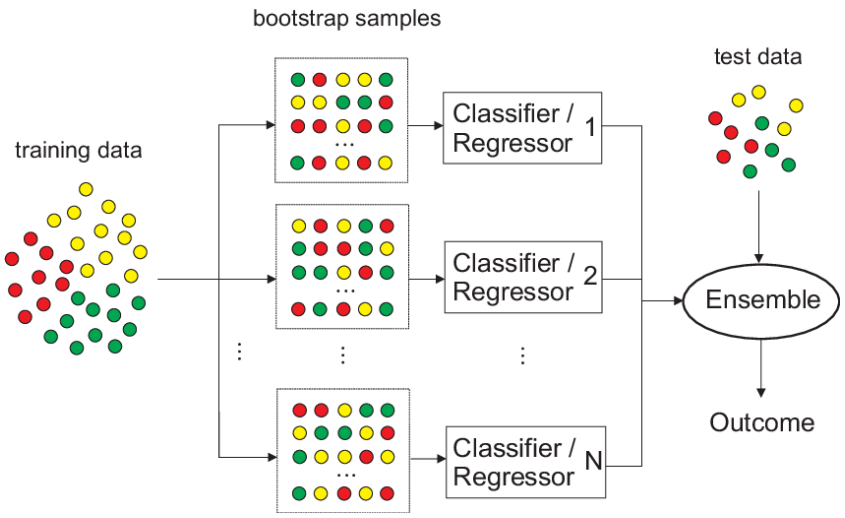

Figure 7: Model architecture of Bagging

3.4.7 Boosting

Boosting aims to reduce bias by training models sequentially. Each subsequent model focuses on correcting the errors made by its predecessor. Techniques like AdaBoost and Gradient Boosting exemplify boosting's ability to combine weak learners into a strong predictive model. Boosting is particularly effective for datasets with intricate patterns and complex decision boundaries.

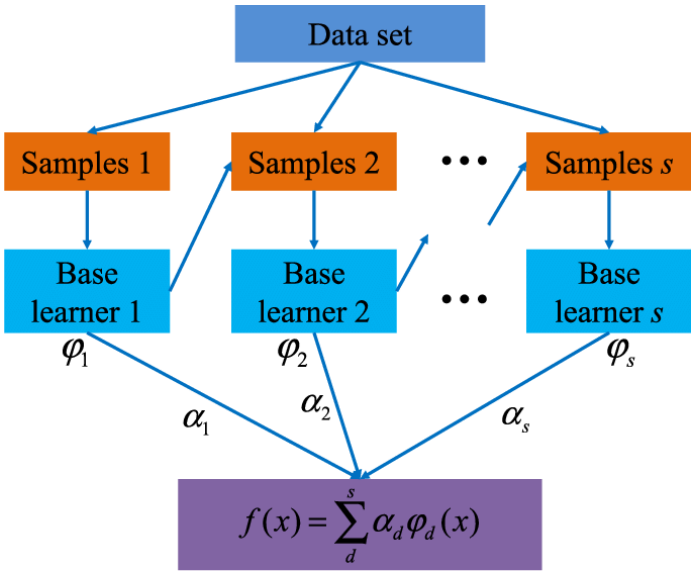

Figure 8: Model architecture of Boosting

3.4.8 Stacking

Stacking, or Stacked Generalization, combines the strengths of multiple models by training a meta-model on their predictions. Base models are trained independently, and their outputs are used as features for the meta-model, which makes the final prediction. This technique leverages the diversity of base models, such as GBM, AdaBoost, and ANN, to achieve higher accuracy and robustness. Stacking proved to be a valuable approach for capturing complementary patterns and improving predictive performance.

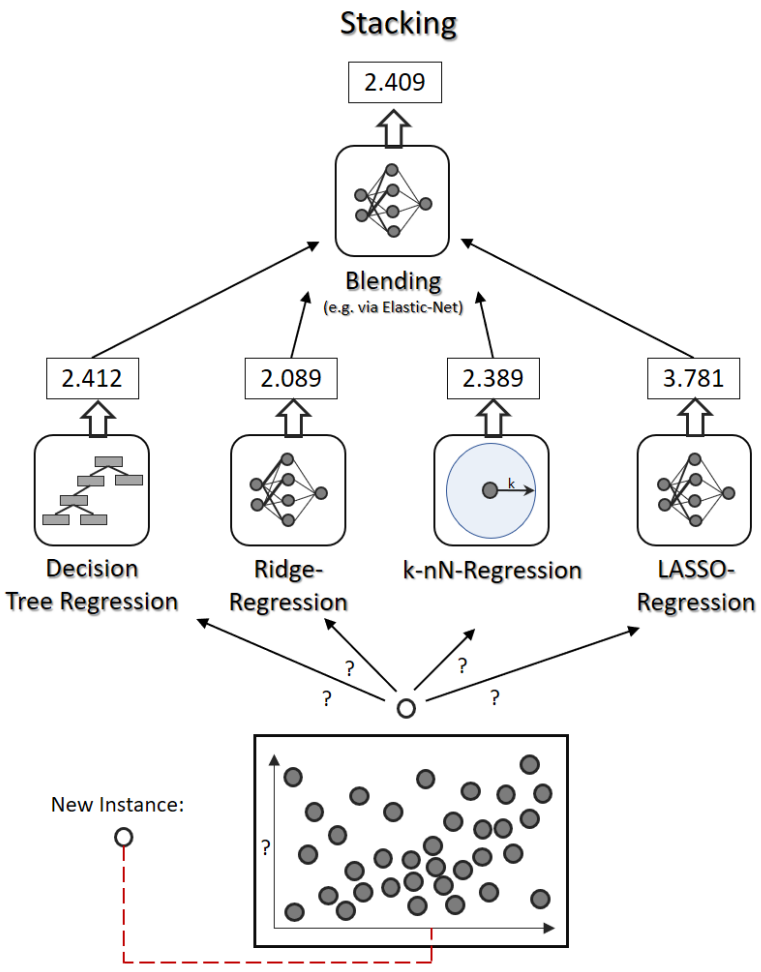

Figure 9: Model architecture of Stacking

CHAPTER 4
EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Results and Discussion

Our findings can be divided into two segments, a) finding insights from data and b) comparing applied machine learning models. After necessary data preprocessing and transformation of the collected data we aimed to Figure out the feature variables with most likely to impact our final output, whether job seekers got job offer or not. And we found most of the variables with positively correlated with the target value though most of the correlation were weak (Figure 10).

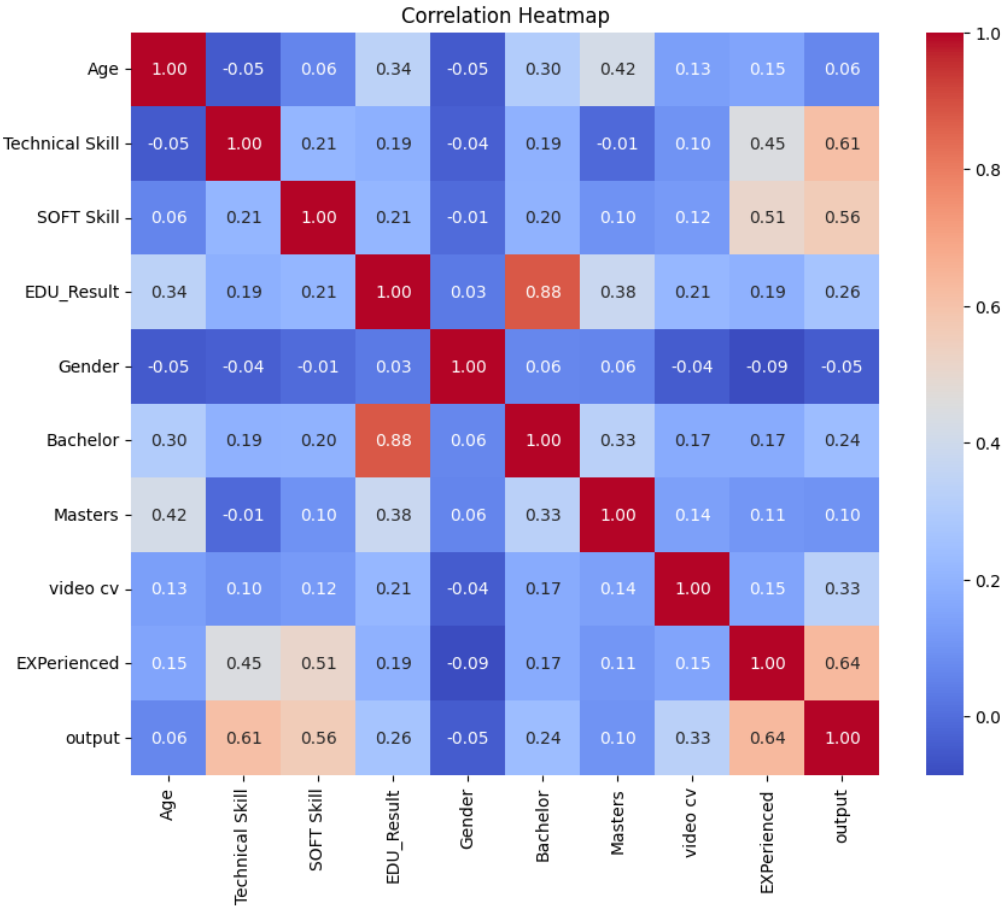

Figure 10: Correlation heatmap for comparing feature variables' relation with the target variable

Among the variables Soft Skill, Technical Skill and Experienced had moderate positive correlation with correlation value ranging between 0.56 to 0.64. Experience was most likely correlated to get job offer. Applicants without experience got job offer but way less comparing the number of apply they have made, as shown in Figure 11.

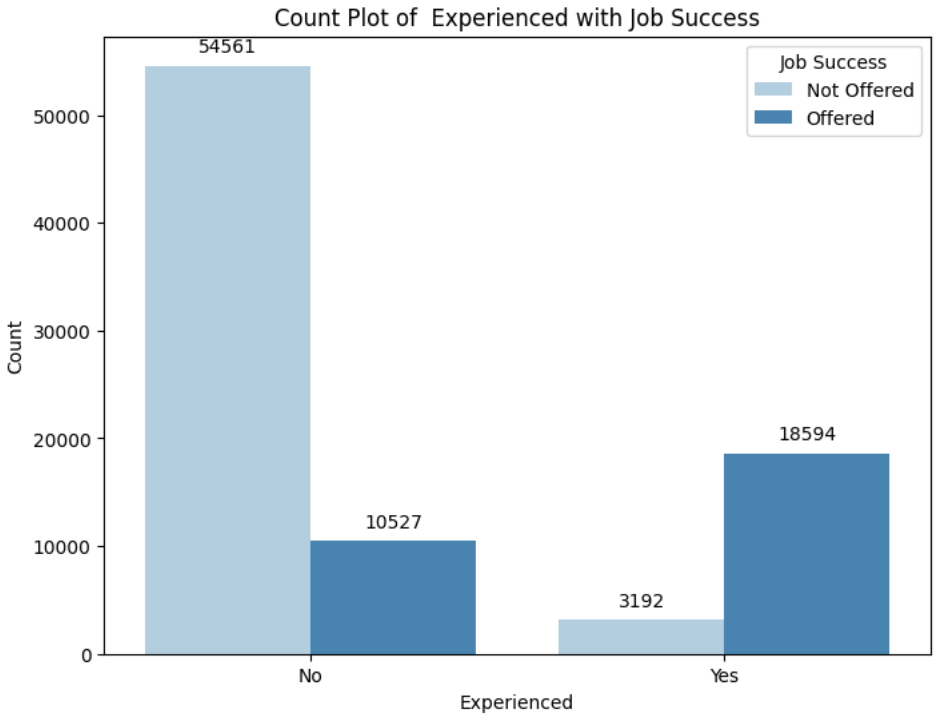

Figure 11: Experience wise count of job offer receiving or not receiving

Table 2: Job offer number and percentage with respect to apply

	Number of Apply	Number of Job Offer	Percentage of Job Offer
Without Experience	65088	10527	16.2%
With Experience	21786	18594	85.3%
In Total	86874	29121	33.5%

As of Table 2, about 33% of application turned into job offer in total, while Adebe et al. (2018) [34] found in their study in Ethiopia that around 3% job offer to the application (75 job offer while 2191 applications were initiated). The number of successful job application

was higher than unsuccessful for the applicants with previous job experience. About 85% applicants with experience received job offer while only 16% applicants received job offer without experience.

In terms of skill, job seekers with technical (job related) and soft skills received more job offers than the job seekers who did not have these. We can observe form the Figure 12, rate of applicants with technical skill got job offer around 76% (over 20 thousand among 27 thousand) while rate of applicants without these skills received offer around 14% (around 8 thousand from around 60 thousand).

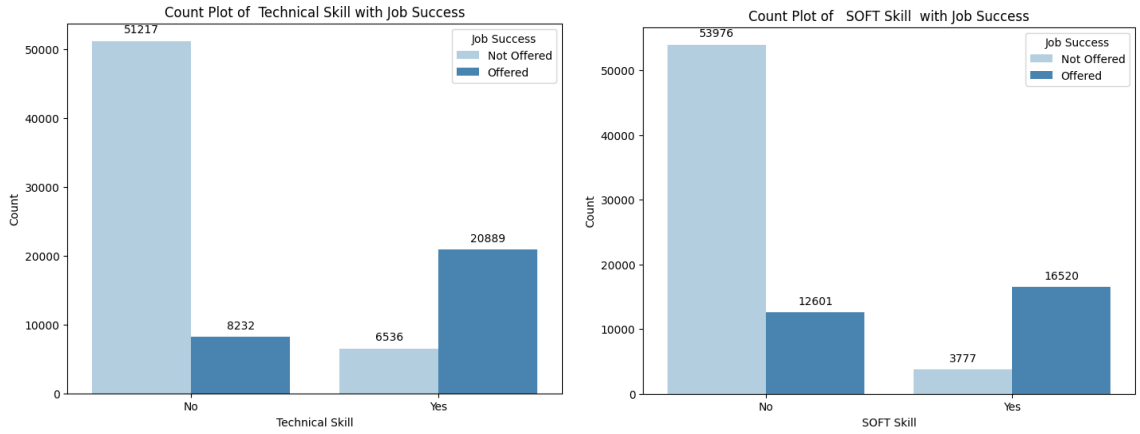

Figure 12: Job success based on Technical and Soft Skill

The number of job seekers without soft skills applied for jobs over 66 thousand but among them got offer only over 12 thousand (around 18% success). On contrast to the job seekers with soft skills, over 16 thousand job seekers received job offer against 20 thousand apply, the success rate was over 80%.

Applicants are likely to receive most of their soft skills from their educational institute, though there are factors to be taken care of, so tried to find insight of their education qualification. We observed that applicants with Bachelor degree got more job offer than the opposite number, though number of job application was higher for the graduated job seekers (Figure 13).

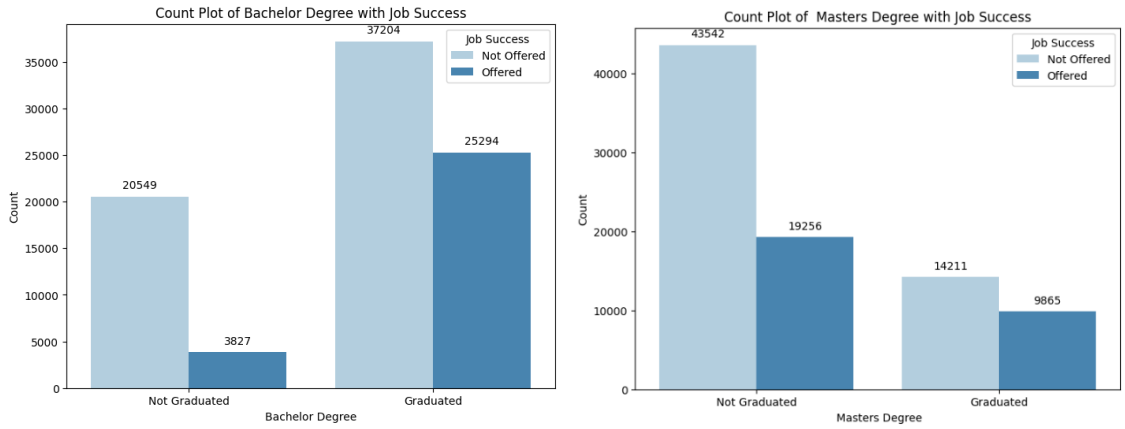

Figure 13: Impact of Bachelor and Masters on Job success

Among the applicants over 62 thousand had Bachelor degree and among 40% received job offer, on the contrary to the Bachelor degree, applicants were quite less with Master's degree, just over 24 thousand had Master's degree but among them also around 40% got job offer.

4.2 Machine Learning Model Discussion

To build a suitable model to predict the job success we applied different machine learning and deep learning algorithms. As our target variable was binary in nature classification method was applied. We used machine learning algorithms like Logistic Regression, Naïve Bayes, AdaBoost, Gradient Boosting, and deep learning algorithm Artificial Neural Network (ANN) for the study, we tried to diversify our choice of algorithms from conventional statistical model to ensembled learning and complex mechanism of deep learning. Upon applying these algorithms to our dataset and estimated the suitable model for the prediction.

To compare the models, we used metrics like accuracy, precision, recall, and F1-score. Almost all the models performed well, all the algorithms (apart from Naïve Bayes Classifier) provided accuracy over 90%, while ANN, Gradient Boosting, and Logistic Regression performed the best with 95% accuracy rate (Table 3).

Table 3: Comparing different algorithms with various metrics

Model	Accuracy	Precision	Recall	F1-Score
ANN	0.95	0.96	0.95	0.95
Naive Bayes	0.65	0.83	0.65	0.65
Gradient Boosting	0.95	0.96	0.95	0.95
Logistic Regression	0.95	0.95	0.95	0.95
AdaBoost	0.92	0.92	0.92	0.92

Since three of our models had the same accuracy, we observed other metrics as well for these three models. All of them performed almost identically in terms of recall and F1-score. But in terms of precision, ANN and Gradient Boosting performed just better than Logistic Regression.

While choosing the model between ANN and Gradient Boosting for our study, we checked the confusion matrix for the both. As we saw in Figure 14, both the models performed almost identical and the true positive and true negative value for the models were close to each other.

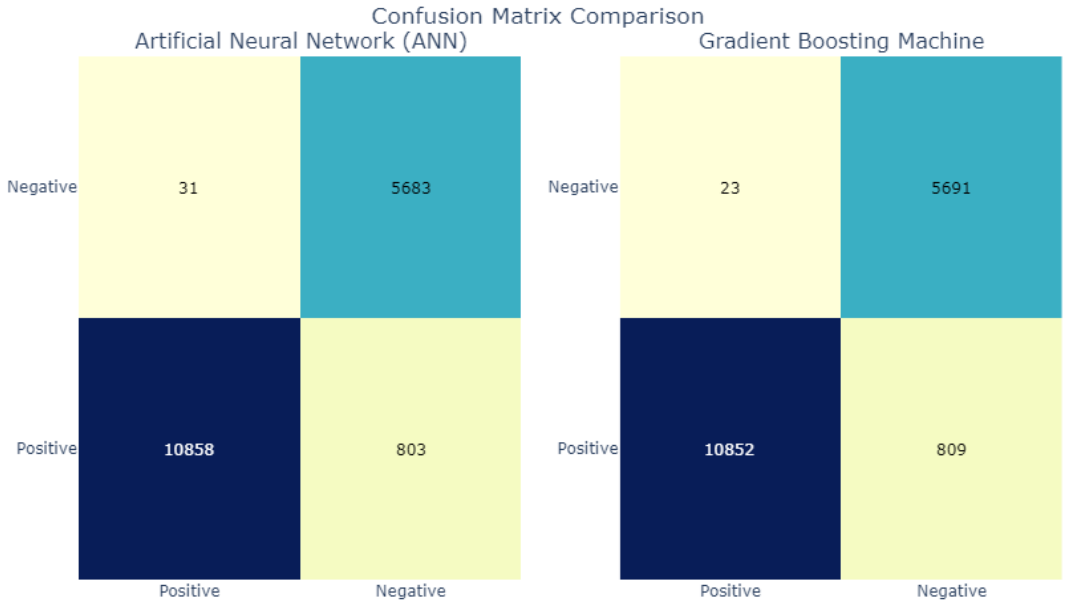

Figure 14: Confusion matrix to compare ANN and Gradient Boosting. Both of them outplayed each other in terms of True Positive and True Negative number.

For ANN, true positive was higher and false positive was lower than the other model, so we would like to suggest Artificial Neural Network (ANN) for future prediction with the similar type of data to find the job success. There are only a few studies where machine learning algorithms were being applied to predict job success based on these sorts of factors, so any comparison is beyond the scope currently, but we believe many studies will intervene by the time we will come forward to taking the study next level.

4.3 Discussion

It is observed that the traditional recruitment methods have often the tendency to focus primarily on academic qualifications without realizing about the multifaceted nature of job performance. They often overlook factors like technical skills, work experience, and soft skills which is very important in the real job sectors. Thus, we have proposed a reliable system by integrating ensemble learning techniques to predict job success. The study was able to achieve an accuracy rate of 95%, which demonstrated a substantial improvement

compared to existing methods. This study unfolds the myth that job success cannot be predicted by academic performance alone. It requires factors like internship experience, and communication skills. A candidate's overall attitude towards professionalism is very significant for ensuring his job suitability. The research also demonstrates how predictive analytics can provide actionable insights for both employers and educational institutions. Employers can streamline their recruitment processes by relying on the model to identify candidates who are most likely to succeed in specific roles, saving both time and resources. Besides the employers' roles, the study provides valuable feedback on for educational institutions about the types of skills and competencies that are most valued. This will help them to propose and design effective courses that will be helpful for students to be better prepared for the workforce. However, it is important to consider that the model's predictions can be biased based on historical data, which may not always account for future shifts in the job market. So, continuous updates and validation are required so that the model's dependency on the quality of the input data do not be influenced and cause biases in recruitment practices or data collection methods. Despite these challenges, the potential for this predictive model to reduce unemployment and address skill mismatch in Bangladesh is significant. By aligning the skills of graduates with the needs of the job market, the study provides a pathway towards a more efficient, productive, and prosperous workforce.

CHAPTER 5
IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

5.1 Impact on society

The impact on society of this study is profound. Now a days, the most ongoing issue in Bangladesh is unemployment of young generations and their mismatch for corporate world. After studying for four years, even from a renowned public or private university, often students are unaware of how to act or prepare themselves for a particular job. Their lack of knowledge and understanding for finding a suitable job makes the situation even more challenging. This is an automated system can be a better solution where user can understand the hiring process, can ensure where they can be a better match with a prediction rate given by the system for their skill sets. Additionally, not only this prediction can help but also gives insights exactly where one need reformations in skill sets or educational achievements which will be helpful to increase the chance of getting a job. This user experience has the potential to create more competent workforce and gain stability in the economic sector. When the newly graduates will be able to equipped with the skills needed to meet the industrial demand this will substantially reduce the unemployment rate. So, this study will serve the society by reducing the mismatch between the graduate skills and employer expectations and increasing job satisfaction while making a productive society. This system will not only encourage the new comers but also make them proactive by helping to form their career planning in a more specific and logical way, eventually leading to successful employment outcomes.

5.2 Impact on the environment

Although this study has no direct environmental impact, however, with the perspective of the broader societal effects can indirectly benefit the environment in the long run. For example, when we can address the unemployment issue and utilize the most of our man power, we can eventually get a reliable economy of the country and have a reliance on

government assistance, thus the conserving resources can be utilized for environmental sustainability initiatives. Furthermore, by making the recruitment process improved through this system the job market needs can reduce the waste of human potential, contributing to a more sustainable society. Additionally, if we consider the widespread adoption of this predictive model, it could drive innovation in sectors like green technologies. If all the industry co-operates a common skillset can be provided to be considerate to the environment as industries recognize the value of using data-driven approaches to solve complex problems.

5.3 Ethical Aspects

The use of ML and DL approaches in the recruitment process raises several ethical considerations which will be discussed in this section. One of the compelling concerns is that these prediction models have higher potential for bias toward the data patterns, especially if the training data is not representative of the entire population. Having only 85,000 data may seem to be a considerable amount for effective model training, however the room for model's biasness does not fully resolve. Furthermore, these data are collected by humans, so it is possible to have human error while organizing such large volume of fata which increases the risk that candidates may be unfairly assessed based on attributes like gender, age, or educational background, leading to discrimination. It is essential that the data used to train the model is collected from reliable and diverse sources which is representative of candidates with every potential attribute to mitigate the risks. Also, it is important to regularly audit the model for fairness. This also a matter of concern that the transparency of the model’s decision-making process is a very sensitive aspect when it is about a black box prediction system fully maintained by AI. It is the duty of the implementer to give the access of job seekers and employers to understand how the model makes its predictions. They also should have the opportunity to appeal or question about the systems decisions if it seems unreliable or awkward. Ensuring that the model is used responsibly and in a way that promotes fairness and inclusivity is crucial to its success.

5.4 Sustainability Plan

Considering the long-term vision, the sustainability of this project is integral, specifically for the market of Bangladesh. As, Bangladesh is a developing country with many aspiring individuals it is important to make the best use of their potential. However, due to the lack of proper roadmap and feedback from experts, this initiative becomes rather difficult. In this case, proposing a system which will produce reliable prediction, provide support and feedback based on emerging trends in job market will be a great success itself. This project is impactful for a society where we have scarcity of acquaintance but having full of knowledgeable and active pupils. So, to ensure the system remains effective we will make updates in this system according to the needs of user. We will provide support and value their feedback and update that eventually to maintain their trust and reliability. The deployed model will be flexible enough to meet any kind of adaption asked by major clients to cope with the cutting-edge technologies. Also, a collaborative network is very important for any project's sustainability. So, making collaboration with educational institutions, government agencies, and private companies will be vital. The scalability of this project will be increase by proposing a wide ranged server which will support vast volume of job seekers and employers' data. The most important aspect is ensuring the investment in training programs for both employers and job seekers to secure that the model's predictions. Ultimately, the success of this research will depend on ongoing collaboration between all stakeholders and a commitment to addressing the evolving needs of the job market in Bangladesh. Regular monitoring and evaluation of the model's performance will be essential to ensuring its sustainability and effectiveness in the long run.

CHAPTER 6
CONCLUSION AND FUTURE WORK

6.1 Summary of the Study

This study presents a novel approach to predict job success utilizing the ML and DL algorithms. The proposed model utilized here incorporates four ML and DL models and three ensemble methods including bagging, boosting, and stacking. The model aims to tackle unemployment and skill mismatch issues in Bangladesh by providing insights into job success and employability. The dataset comprises 85,000 records which have been processed with normalization and one-hot encoding or label encoding. Following this a feature importance and correlation analysis were analyzed to prioritize the key attributes among gender, age, education, skills, and experience. After the proposed model was build, we performed a hyperparameter tuning using grid search and random search techniques. Furthermore, the model's performance analysis was conducted by evaluation metrics such as accuracy, precision, recall, F1-score, and ROC-AUC. We also employed Cross-validation to ensure the proposed model's robustness and generalizability.

6.2 Conclusions

The primary objective of this research was to construct an algorithmic model to determine potential job success in Bangladesh employing various machine learning approaches. Taking a closer look at variables such as educational qualifications, technical skills, soft skills, and relevant working experience, we were able to identify the major predictors of employee job success. Our findings indicate that soft skills as well as technical skills have to be in place to enhance the ability to get jobs while work experience is critical to increasing the possibility of success in these jobs.

In addition, there were notable job success prediction models run using machine learning with over 90% performance accuracy reached. Of all the algorithms tested, Artificial Neural Networks model emerged as the best performing in precision and accuracy over the

other models. This indicates that ANN is capable of dealing with complex functions of the relationship between predictor variables and the outcome variable, which in this case is job success.

The model developed has many practical aspects. It can help job applicants recognize their strengths and shortcomings, helping them to choose careers that are best for them, and improving the likelihood them succeeding in such careers. The model can also help employers in cutting time spent on recruitment by helping to identify candidates who are more likely to perform well in a particular job.

We believe this research will help to address problems like unemployment and skill shortage in Bangladesh as by providing a forecasting tool that evaluates the likelihood of achieving job success, we seek a more robust enhancement in addressing the education-employment gap and in closing the society's inequities for the future.

6.3 Implication for Further Study

This study demonstrates a novel approach for job success prediction utilizing the attributes like education, skills, and experience. Despite the robustness of this study's outcome, further research could be focused on more expanded version of the dataset where we can add more varied attributes considering socio-economic and regional aspects. More data on the progression of skill set over time should also be a key point while predicting the job success, for example the longitudinal data, leadership quality, and influential attitude toward relatable events of a particular field. Besides, the integration of more advance and cutting-edge algorithms such as integrating reinforcement learning which have a great potential to improve the model's adaptability to real-time labor market changes, will also be a target. We could also differentiate and include data of soft and technical skills which will be very insightful for feature selection and provide a nuanced explanation in the job success rate, this way we can enhance the model's explain ability, as we are ensuring the effective features and selecting them based on their proper influence in the field. Including data of other countries will be a positive aspect for the model which will ensure its fair

prediction in diverse data patterns and reduce biasness. Combining all these future implications we can further expand out study with a greater success which will have a reliable applicability in the society.

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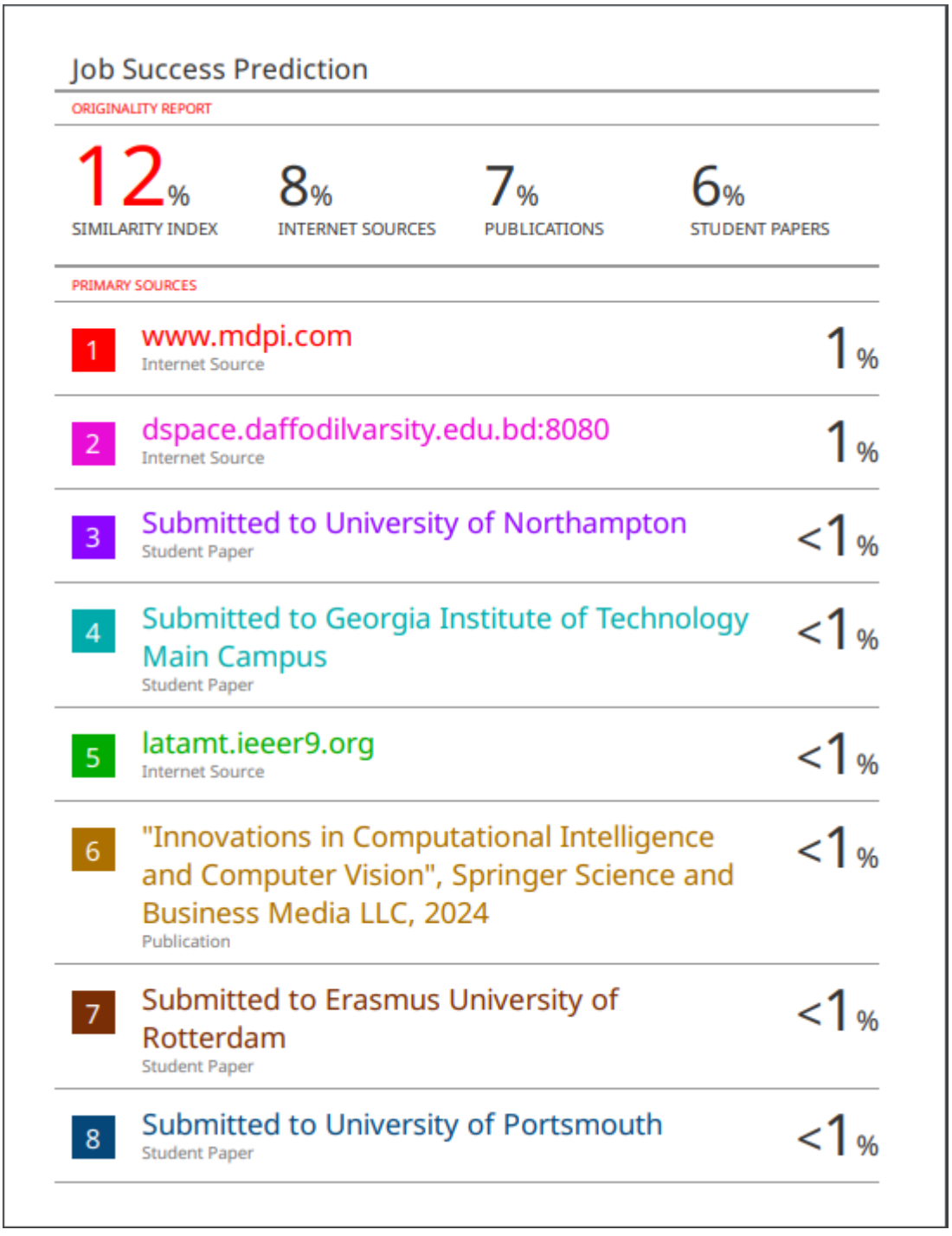

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