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CUSTOMER CHURN PREDICTION USING MACHINE LEARNING AND ARTIFICIAL NEURAL NETWORK ALGORITHMS

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ABSTRACT :

In the business world, the term "customer analytics" has gained popularity. By using predictive analytics to forecast client behavior, is utilized to make crucial judgments. Churn studies have been applied for many years to boost profit and enhance connections between the company and its customers. Because they can handle vast volumes of consumer data, Machine learning algorithms and Deep learning algorithms like Artificial neural networks (ANNs) are frequently utilized in churn analysis. To forecast future customer attrition in the retail sector, this study employed deep learning and machine learning models. For churn prediction, the suggested models were contrasted with other popular machine-learning techniques. Classification tools such as precision, recall, sensitivity, and F1-score.

Keywords: Customer analytics, Machine learning algorithms, Deep learning techniques, Churn prediction, Accuracy, Classification tools.

INTRODUCTION

The way firms operate has changed as a result of global development and digitalization. One result of the digital revolution, which offers businesses both benefits and challenges, is subscription-based services. Customers are confronted with a greater supply of subscription-based services due to the wealth of available information. It may become harder for businesses to retain clients, which would cause issues. But digitization also has the potential to save labor costs, boost productivity, and improve comprehension of an organization's activities. These advantages are necessary to maintain competitiveness and get an advantage over competing businesses. Information technology is making data and information more widely available.

Because of its capacity to manage and analyze massive volumes of data, deep learning, and machine learning have become more popular as a result of this expansion. Businesses can utilize the valuable data that is retrieved from the stored data to help with important decision-making for business expansion. In subscription-based firms, the ideas of knowledge management and customer relationship management have garnered increased attention, with a focus on allocating resources to customer-centric operations to gain a competitive edge. Client knowledge is the information that companies learn from their interactions with clients. Systems for managing customer relationships assist companies and clients in gathering, storing, and evaluating data.

The number of operators and technological advancements in the telecommunications industry have led to increased competition. Three key tactics have been put out to increase revenue:

i. Gaining new clients,
ii. Upselling current clients, and
iii. Boosting client retention is the three main goals.

Since it is far less expensive to keep a current customer than to find a new one, the third technique is the most successful. To implement the third strategy, businesses need to reduce the possibility of customer churn—the phenomenon where a consumer decides to stop using a service provider. Businesses engage in customer churn prediction to identify potential at-risk consumers and implement proactive strategies to keep them as clients.

Predicting which consumers are likely to leave is made easier by analyzing their behavior; this is especially important for businesses that depend on subscription-based revenue. Customer turnover represents a huge loss for businesses worldwide because they have previously expended resources to acquire these clients. Depending on the reason a customer might leave, preventative efforts could include providing an additional service or lowering the price.

CUSTOMER CHURN PREDICTION :

When consumers or subscribers stop using a service is known as customer churn. For companies in a variety of sectors, particularly those that provide subscription-based services like retail software as a service, and telecommunications, predicting customer attrition is essential. It is the capacity to predict which clients are most likely to discontinue utilizing a business's goods or services within a certain time frame. In the telecom sector, customers can actively switch between many service providers. For companies in a variety of sectors, particularly those with recurring or subscription-based

revenue models, predicting customer attrition is an essential responsibility. Customers who discontinue doing business with a company are referred to as churn.

The amount of consumers that leave is notable since it is significantly less expensive to retain existing clients than to find new ones. The first step in identifying potential churn early on is to develop a comprehensive picture of the clients and their interactions through a range of channels. Thus, these organizations could be able to grow and thrive while holding onto their market share if they can control attrition. Their network of customers grows as their profit margins increase and as their initial costs decrease.

OVERVIEW OF ML AND ANN ALGORITHMS

Machine learning

The study and development of statistical algorithms that can identify patterns in data, extrapolate those patterns to new data, and perform tasks without explicit supervision is known as machine learning (ML) in the field of artificial intelligence. In numerous domains, such as computer vision, audio recognition, email filtering, natural language processing, agricultural, and medical, machine learning techniques have been used. The phrase "predictive analytics" refers to applying machine learning to various business problems. While statistics is not the only source of information used in machine learning, computational statistics is a major source of ideas. Mathematical programming, or mathematical optimization, techniques provide the foundation of machine learning.

These kinds of education are typically divided into the following categories: Depending on the size of the problem and the kind of data being utilized, one algorithm may be better suited than the other for supervised or unsupervised learning. marketplace, but also develop and prosper. The more customers they have in their network, the higher the profit and the lower the beginning cost. As a result, implementing a solid retention strategy and reducing client attrition is critical to the company's success. The algorithms used in machine learning are:

i. Logistic Regression
ii. Decision Tree
iii. Random Forest

Logistic Regression

A common machine-learning technique is logistic regression. It predicts the categorical dependent variable using the assigned set of independent factors. To predict a categorical dependent variable's outcome, utilize logistic regression. Consequently, the outcome needs to be a discrete or category number. This delivers probabilistic values that range from 0 to 1, instead of giving the exact numbers 0 and 1. The answer could be any number between 0 and 1, yes or no, etc. Logistic regression and linear regression are similar, except that they have different purposes.

Classification problems are best solved using

logistic regression, whereas regression problems are best solved using linear regression. Instead of fitting a regression line (0 or 1), logistic regression uses an "S" shaped logistic function to predict two maximum values. The probability of various outcomes, such as whether the cells are malignant or not if a mouse is overweight based on its weight, and so on, are displayed on the logistic function's curve.

Decision Tree

Decision trees are a supervised learning technique most commonly used to solve classification problems, while they can also be used to tackle regression problems. The classifier is built like a tree, with leaf nodes signifying individual outcomes, branches representing decision rules, and core nodes reflecting dataset properties.

Random Forest

Random forests, also called random choice forests, are ensemble learning approaches that produce a huge number of decision trees during the training phase when used for regression and other tasks. The random forest's output is the class that the majority of trees select for classification jobs.

The mean or average forecast for each tree is returned in regression tasks. Random decision forests mitigate the tendency of decision trees to overfit their training set. Random Forest is a popular machine learning algorithm for supervised learning techniques.

One popular machine learning algorithm for supervised learning techniques is called Random Forest. It can be applied to classification and regression-based machine learning issues.

ANN (Artificial Neural Network)

In the business world, keeping customers happy and coming back is super important. But sometimes, customers decide to stop using a company's services or buying its products - this is called "churn". To help businesses figure out which customers might leave, they're using fancy tech called Artificial Neural Networks (ANNs). This project is all about using an ANN to predict churn. We'll go through how we clean up the data, choose which customer info to focus on, design the network, and train it to make accurate predictions. We'll also check how well our ANN does compared to traditional methods. By using ANNs for churn prediction, businesses can get ahead of the game. They can use this info to keep customers happy, come up with better strategies, and grow even when things get tough in the competitive market

In Artificial Neural Networks (ANNs), optimizers are algorithms that help the network
learn and improve its accuracy during training. They tweak the weights and biases of the network to minimize errors and make better predictions. An artificial neural network (ANN) is composed of linked units or nodes that resemble neurons in the brain. These are connected by edges that resemble synapses in the brain. An artificial neuron sends a signal to further linked neurons after digesting signals from existing linked neurons.

An Artificial Neural Network (ANN) is made up of several layers, each with its unique role in processing information. Let's break down these layers in a simple way:

Input Layer:

- This is the first layer where the network "sees" and takes in the data.
- It's like the eyes and ears of the network, collecting raw information.
- Each node (or neuron) in this layer represents a different piece of information about the input data.

Hidden Layers:

- These are in-between layers that process the input data and learn from it.
- They're called "hidden" because we don't interact with them directly; they're thinking about the scenes.
- Each hidden layer consists of multiple neurons that perform calculations on the input data.
- The more hidden layers a network has, the more complex patterns it can learn.

Output Layer:

- This is the final layer that gives us the network's prediction or output.
- It interprets the processed data from the hidden layers and produces the result.

PROPOSED METHOD

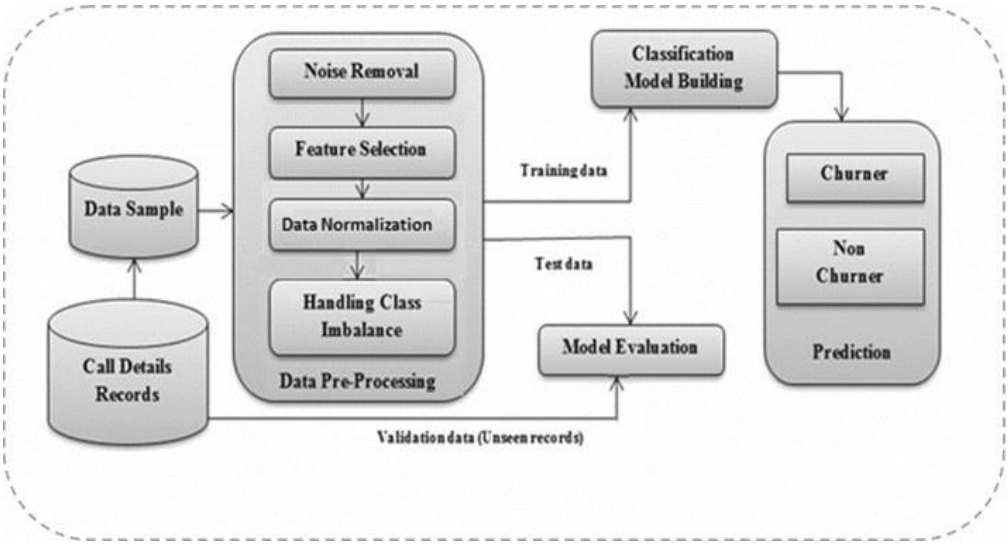


Fig 1: Proposed Method for Customer churn prediction

Comprehensive information about client demographics, past purchases, usage trends, interactions with customer care, and other pertinent data will be gathered. We'll clean up, modify, and get this data ready for analysis. To develop new features that extract valuable insights from the data, we'll use feature engineering methodologies. By taking this action, our models will become more predictive. We will be able to recognize trends, comprehend churn-influencing causes, and obtain insightful knowledge about consumer behavior by doing EDA. To maximize performance and avoid overfitting, the chosen model or models will be trained on historical data.

Analyze the model's predictions to learn more about the variables affecting customer attrition. Make use of these insights to create focused client retention tactics, such as customized marketing campaigns, better customer support, loyalty initiatives, or superior products. Refine the churn prediction model iteratively using fresh data and feedback loops from tactics that have been put into practice. As new features or data sources become available, include them in the model to increase its prediction capacity. Refine the churn prediction model iteratively using fresh data and feedback loops from tactics that have been put into practice. By implementing this suggested approach, companies can create strong systems for predicting customer turnover, which facilitates proactive customer relationship management and supports long-term company performance.

METHODOLOGY :

The study's framework and data preparation were covered in this section. According to the literature analysis, if a customer skips out on purchases for three months or longer, they are deemed lost in the retail industry. Therefore, a customer is classified as a churn customer if they haven't purchased anything for three months or more, and other customers are classified as non-churn customers. Just twenty-four months' worth of data were utilized to train and test the datasets after it was known which consumers were attrition. Using a standard validation strategy, the dataset (5747) is randomly split into 70% for training and 30% for testing.

IMPLEMENTATION & RESULTS

Logistic Regression

- *Understanding Customer Behavior*: Logistic regression looks at different factors or behaviors of customers, like how often they use a service, how long they've been a customer, or their interactions with customer support.
- *Predicting Churn Probability*: Instead of saying outright whether a customer will churn or not, logistic regression gives us a probability score. For example, it might say there's an 80% chance that a particular customer will churn based on their behavior and characteristics.
- *Identifying Risk Factors*: Logistic regression helps identify which factors or behaviors are strongly associated with customer churn.
- *Taking Preventive Actions*: By knowing which customers are at higher risk of leaving, companies can take preventive actions to retain them
- *Improving Retention Strategies*: Logistic regression helps in refining retention strategies by focusing efforts on the most critical factors that influence churn. It enables companies to allocate resources effectively to maximize customer retention.

Obtained Results:

i) Accuracy: 73.6 %

ii) Confusion Matrix:

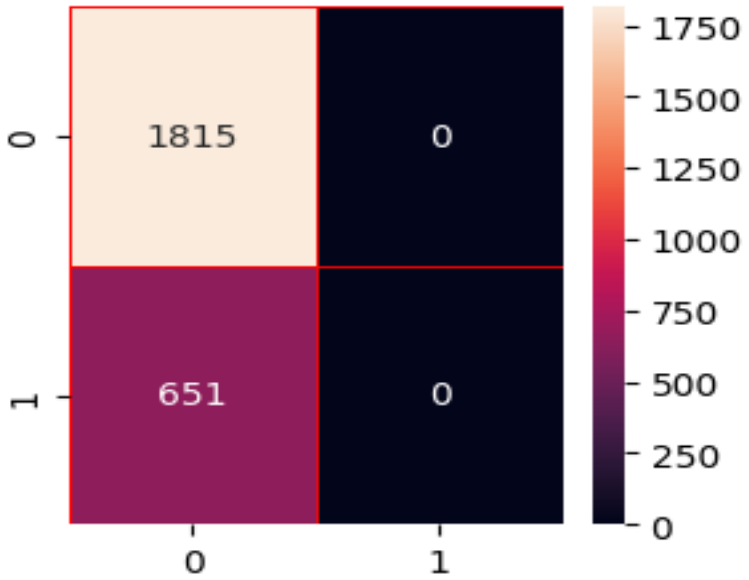


Fig 2: Confusion Matrix for Logistic Regression

iii) Classification Report:

Churn	Precision	Recall	F1-SCORE	Support
0	0.74	1.00	0.85	1815
1	0.00	0.00	0.00	651

Table 1: Classification Report for Logistic Regression

Decision Tree

Purpose of the decision tree in a customer churn project:

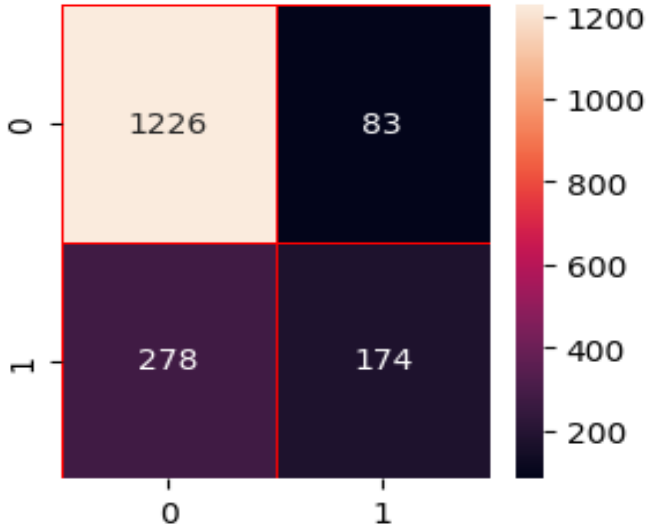
- **Understanding Churn Drivers**: Decision trees help identify key factors influencing customer churn, such as service quality, pricing, or competitor offerings.
- **Segmentation**: They segment customers into groups based on similarities in behavior and characteristics, aiding targeted retention strategies.
- **Predictive Power**: Decision trees predict the likelihood of churn for individual customers based on historical data, enabling proactive intervention.

- **Interpretability**: Their visual nature allows easy interpretation, facilitating an understanding of why customers churn and guiding actionable insights.
- **Feature Importance**: Decision trees rank predictors by importance, guiding resource allocation toward addressing critical churn drivers.
- **Transparency**: They offer transparency in decision-making, fostering trust and buy-in from stakeholders in implementing churn reduction strategies.
- **Handling Complexity**: Decision trees can handle complex relationships between variables, capturing nuances in customer behavior and churn dynamics

Obtained Results:

i. Accuracy: 74.38
ii. Confusion Matrix:
iii. Classification Report:

Fig 3: Confusion Matrix for Decision Tree



Churn	Precision	Recall	F1-SCORE	Support
0	0.82	0.94	0.87	1309
1	0.68	0.38	0.49	452

Table 2: Classification Report for Decision Tree

Hyperparameter tuning of Decision tree Classifier

After Tuning the decision tree obtained best parameters are:

Criterion: Gini
max_depth: 4
min_samples_leaf: 5
min_samples_split: 2

Obtained Results:

i. Accuracy: 79.5
ii. Confusion Matrix:

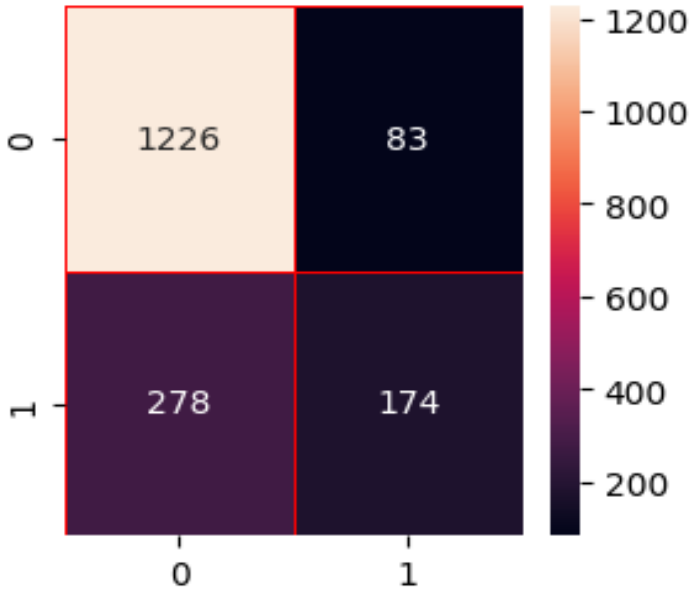


Fig 4: Confusion Matrix for Hyperparameter Tuning of Decision Tree Classifier

I. Classification Report:

Churn	Precision	Recall	F1-SCORE	Support
0	0.82	0.94	0.87	1309
1	0.68	0.38	0.49	452

Table 3: Classification report for Hyperparameter tuning of Decision tree classifier

Random Forest

A Random Forest can be a useful tool in customer churn projects to identify which customers are most likely to leave. How it fits into such a project is as follows:

- Preprocessing Data: Before using the
- To make sure the data is prepared for modeling, the Random Forest Classifier should be used along with data pretreatment techniques including handling missing values, encoding category variables, and scaling numerical features.
- Feature Selection: At each split, Random Forests automatically pick features by taking into account a random collection of features.
- Model Training: Using historical data that includes details on previous customer behavior, demographics, and interactions with the company, the Random Forest Classifier is trained.
- Cross-validation: approaches, such as k-fold cross-validation, can be utilized to assess the model's performance on untested data and ensure its robustness.
- Prediction and Evaluation: The Random Forest Classifier can forecast new customer attrition once it has been trained.
- Model deployment and monitoring: To guarantee the model's continuous efficacy in anticipating customer attrition, it's critical to track its performance over time and retrain it with fresh data regularly.

Obtained Results:

i) Accuracy: 78.98
ii) Confusion Matrix:

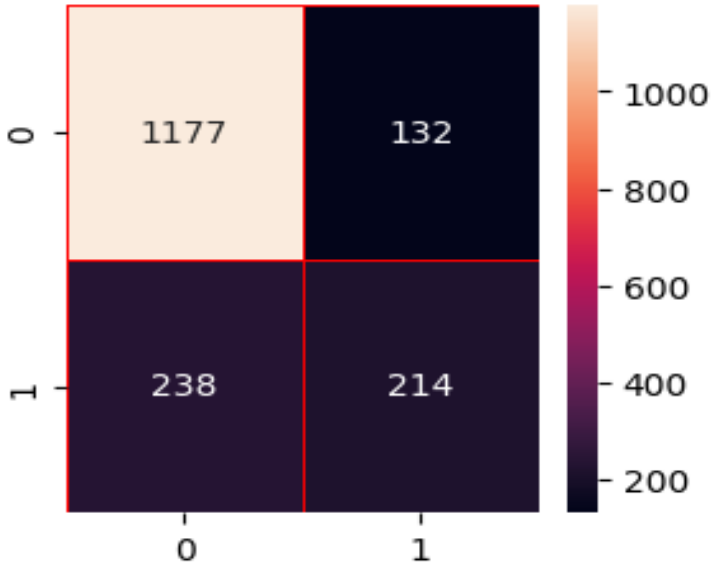


Fig 5: Confusion Matrix for Random Forest Classifier

a. Classification Report:

Churn	Precision	Recall	F1-SCORE	Support
0	0.83	0.90	0.86	1309
1	0.62	0.47	0.54	452

Table 4: Classification Report for Random Forest

Artificial Neural Network

Model: "sequential_1"

layer (type)	output Shape	parameters
dense_1(Dense)	(None,100)	2000
dropout_1 (Dropout)	(None, 100)	0
dense_2(Dense)	(None, 1)	101

Table 5: Model Summary

Total parameters: 2101 (8.21 KB)
Trainable parameters: 2101 (8.21 KB)
Non-trainable parameters: 0 (0.00 Byte)

Obtained Results:

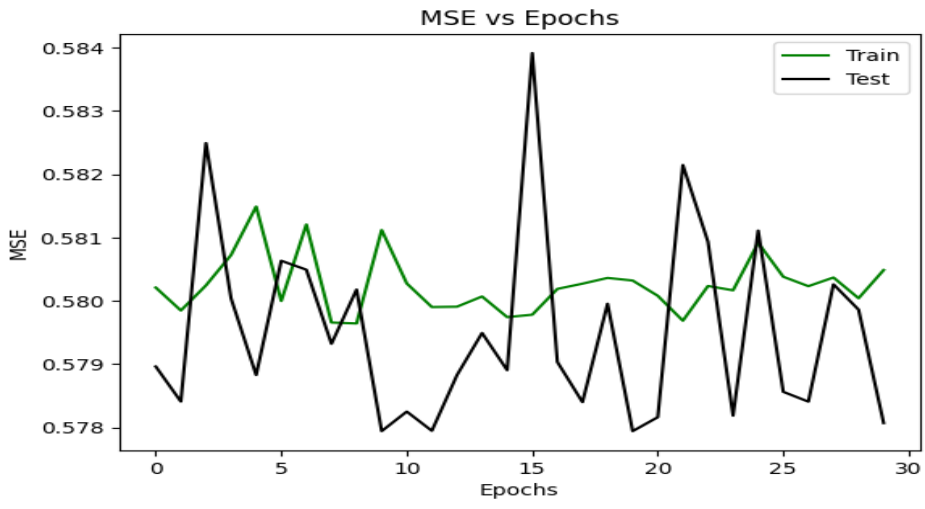


Fig 6: Mean Square Error for ANN

- Mean Square Error for train data is 0.5816
- Mean Square Errorfor test data is 0.5838

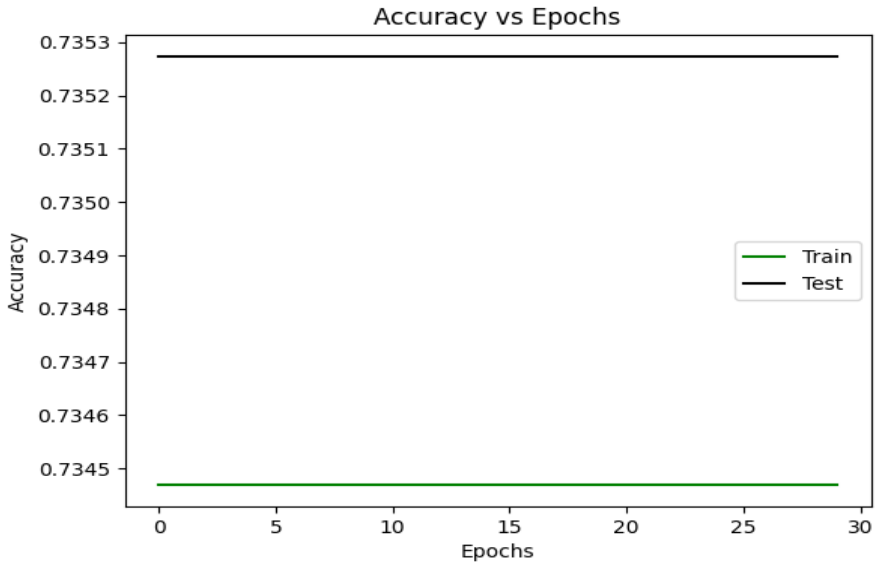


Fig 7: Accuracy for ANN

- The Accuracy for train data is 73.44 %
- The Accuracy for test data is 73.53 %

CONCLUSION :

In summary, different models for predicting customer churn offer different benefits and performance levels, such as interpretability versus accuracy. However, the business ultimately determines which model to use. These models include Random Forest, Logistic Regression, Decision Tree and Artificial neural network algorithms. Organizations may effectively reduce attrition and improve client retention tactics by knowing the advantages and disadvantages of each model.

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