TKR COLLEGE OF ENGINEERING & TECHNOLOGY

AUTONOMOUS

LOAN ELIGIBILITY PREDICTION USING MACHINE LEARNING

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INTRODUCTION :

- In the realm of financial decision-making, predicting loan eligibility is a critical task that can be significantly enhanced through the power of machine learning. Traditional methods often rely on fixed criteria, but machine learning allows for a more dynamic and data-driven approach. By leveraging historical data, we can create models that learn patterns and relationships between various factors influencing loan approval.
- **Objective:** The primary goal of this project is to develop a robust machine learning model capable of predicting loan eligibility based on individual characteristics. By analyzing a set of features such as income, credit score, employment status, and more, the model will provide a quantitative assessment of whether an applicant is likely to be approved or denied a loan.

LITERATURE SURVEY

S . No	Article	Author	Year of publica tion	Methodology	Remarks	Publisher
1.	Machine Learning Models for Predicting Bank Loan Eligibility	OrijiUEb Ch Ugwuishiwu	2022	KNN, LR, SVM, RF, Gradient Boost, Decision Tree	Provides high Accuracy and more efficient predictions using algorithms	IEEE
2	Customer Loan eligibility Prediction using ML	A Shaik, KS Asritha , N Lahre	2022	Random forest classifier, passive aggressive classifier, Multinomial Naïve baye's, support vector and adaboost classifier	It highlights the profits, so it minimizes the risks of defaulter and optimizing decision making in the lending process.	Publishoa .com
3	A stydy on ML Algorithm for Enhancement of Loan Prediction	Prateek Dutta	2021			IRJMETS

4	**Loan Prediction using ML Algorithms**	**Sanket Bhattad, Sumit Bawane , Shwetha Agarwal**	**2021**	**Emphasizes dataset, Logistic Regression, Decision Tree, Random Forest Algorithms are used**	**Highlights repayment capability of customers and approval of loan based on credential score of the customer. And ensures efficient loan prediction**	**IJCST**
5	Analysis of Loan Availability using ML Techniques	Sharayu Dosalwar , Ketki Kinkar, Rahul Sannat	2021	Logistic Regression, SVM, Decision Trees, KNN, Random Forest, Linear Models, XG Boost Classifier, KNN, Naïve Bayes	Ensures more informed decisions on lending, checks whether a customer is defaulter or not by analyzing their personal data, minimize risks	IJARSCT
6	ML Techniques For Recognizing the Loan Eligibilty	Mr. Abhiroop Sarkar	2021	Logistic Regression, Random Forest, Decision Tree Algorithms are used	It addresses complexities of loans, automates loan prediction process, provides accurate and immediate eligibility analysis	IRJMETS
7	Prediction for Loan Approval using ML Algorithm	Ashwini S.Kadam,Shraddha R. Nikram, Ankitha	2021	SVM , Naïve Bayes algorithms are includes in its processing steps	Predicts Loan defaulters, focuses on predictive analytics, minimizing losses by accurate predictions	IRJET

8	**The Loan Prediction Using ML**	**Dr. C. K. Gomathy , Ms.CharuLatha , Mr. Aakash , Sowjanya**	**2021**	**Optimize using Naïve Baye's techniques such as grid or random searches and Naïve Baye's model**	**Enhances accuracy of selecting loan approvals and optimizes the approvals**	**IRJET**
9	Customer Loan Prediction using Supervised Learning Technique	Udaya Bhanu , Dr. S. Narayana	2021	Random Forest, Decision Trees, SVM, Logistic Regression and KNN	Enhancing efficiency and predicting loan approvals	IJSRP
10	A comparative study on Loan Eligibility	A Dagar	2021	Logistic Regression, Random Factor, SVM, XG Boost	Provides easy way of deserving applicants with efficiency	ijsret.com
11	Loan Prediction using Decision Tree and Random Forest	Kshitiz Gautam Arun Pratap Singh Keshav Suresh Kumar	2020	Decision Tree, Random Forest classification problems	By focusing clients background it determines the repayment capabilities of customers and approves loan	

12	ML Techniques for Recognizing the Loan Eligibility	Mr. Abhiroop Sarkar	2021	Logistic Regression, Decision Tree, Random Forest	Addresses loans complexities, provides accurate eligibilities for loans	Irjmets.com
13	Predict Loan Approval in Banking system ML Approach for Cooperative banks Loan approval	Amrutha S. Aphale Dr.Sandeep R. Shinde	2021	Naïve Baye's, Linear Regression, KNN, ensemble Learning , Decision Trees	Enhances efficiency and accuracy in predicting decisions on loan approval or rejection	IJERT
14	Logistic Regression Based Loan Approval Prediction	SA Vangaveeti, NL Venna, PNSRY Kidambi	2020	ML Techniques especially Logistic Regression to predict approval or rejection Of Loan	Predicts a model for decision making process for loan approval	JAAC
15	ML based Loan Approval Prediction System A Novel Approach	MKJ Kannan, AR Nithej	2023	Logistic Regression, Decision Tree, Random Forest, K Nearest Neighbors, Artificial Neural Network, Naive Bayes, Adaboost, and Voting Classifier	Improves accuracy in loan approval prediction and minimizing losses	ijircce.com

16	Prediction of Customer Loan Eligibility Using Random Forest Algorithm	Srikanth Eadara Phani Kumar	2023	Especially uses Random Forest models and evaluates on it	Predicting loan defaulters and approving loan to the eligibilities	Jespublication.com
17	Loan Default Identification and its effect	Gopal Choudhary , Yash Garud , Akshil Shetty, Rumit Kadakia , Sonali Borase	2019	Logistic Regression , Random Forest algorithms	Enhances accuracy in predicting credits and manages risks	IJSRCSEIT
18	Comparative analysis of Bank Loan Defaulter prediction using ML Techniques	Spoorthy B Shwetha S Kumar Anusha P Rodrigues	2021	Random Forest, Naive Bayes (Gaussian, Multinomial, and Bernoulli models), and Support Vector Machine (Linear, Gaussian RBF, and Polynomial kernels)	This research is crucial in enhancing the decision-making process for loan approvals in the dynamic banking sector.	IEEE
19	ML Algorithm to predict Fraudulent Loan Requests	Nazmul Hasan Tanvir Anzum Tareq Hasan Nusrat jahan	2021	SVM, Decision Tree, Logistic Regression, Ada-Boost, Random Forest, KNN	Achieving accuracy with KNN and making informed decisions and mitigating risks	IEEE

20	**Loan analysis predicting defaulters**	**Mudit Manish Agarwal, Harsha Mahendra Shrike, vivek prafullbhai Vadhiya**	**2022**	**SMOTE and SMOTE ENN for imbalanced datasets , Decision Tree, Logistic Regression, Ada-Boost, Random Forest**	**The development of a credit risk scoring for predicting loan defaults sounds like a valuable initiative. Integrating this model into a user-friendly web application could indeed enhance accessibility and usability for stakeholders in the banking sector**	**IRJET**
21	Accuracy prediction for loan risk using ML models	Anchal Goyal, Ranpreet Kaur	2016	Decision Tree, Linear Model, Random Forest, SVM and others	It highlights the potential for decision support in credit approval process	IJCST
22	An improved light gradient boosting ML algorithm based on swarn algorithms for predicting loan default of peer-to-peer lending	Much Aziz Muslim , Yosza Dasril, Muhammad saman	2022	Combination of swarm and lightGBM algorithms	Challenges the Unbalanced class process, strong generalization for predicting loan default in finance	ijeecs.com

Article - 1

Article 1: Machine Learning Models for Predicting Bank Loan Eligibility

- **Introduction:** The project aims to leverage machine learning algorithms to enhance the loan approval process in the banking sector. With a focus on predicting loan eligibility, the study utilizes six different algorithms: Random Forest, Gradient Boost, Decision Tree, Support Vector Machine, K-Nearest Neighbor, and Logistic Regression. The motivation stems from the need to streamline and improve the accuracy of loan approval processes in the financial industry.

Methodology:

1. **Dataset:** The research employs the 'Loan Eligible Dataset' from Kaggle, featuring attributes such as gender, marital status, education, income, credit history, and more.
2. **Data Preprocessing:** Techniques include Synthetic Minority Oversampling (SMOTE) for handling imbalanced classification problems, one-hot encoding for categorical variables, and normalization for feature scaling. Exploratory Data Analysis (EDA) is conducted to gain insights into the dataset.
3. **Algorithms Used:**

    1. K-Nearest Neighbor
    2. Support Vector Machine
    3. Decision Tree
    4. Random Forest
    5. Gradient Boost
    6. Logistic Regression

1. **Model Evaluation:** Performance metrics such as Confusion Matrix and F1 Score are employed to evaluate the accuracy, precision, and recall of each model.

Outcome:

- The research results indicate high-performance accuracy across the machine learning models. The Random Forest algorithm achieved the highest score of 95.55%, while Logistic Regression had the lowest at 80%. The ensemble techniques of bagging (Random Forest) and boosting (Gradient Boost) contributed to optimal predictive models. The study provides valuable insights into the effectiveness of machine learning in predicting loan eligibility, with potential applications in improving the loan approval process in the financial industry. The comparison of models helps in identifying the most suitable algorithm for the given task.

Article - 2

Customer Loan Eligibility Prediction using Machine Learning

- **Introduction:** In the contemporary banking landscape, the ability to predict customer loan eligibility is a crucial task. The revenue generated from loans significantly contributes to a bank's profit, making it imperative to identify potential credit defaulters. Manual assessment of credit risk is time-consuming, and despite rigorous verification, there's no guarantee of the borrower's security. The project aims to address this challenge by leveraging machine learning models for accurate loan eligibility predictions.

Methodology:

- The proposed methodology involves the development of an automated loan prediction platform using machine learning algorithms. The dataset includes thirteen key factors such as gender, education, income, credit history, etc. Five distinct machine learning algorithms — Random Forest Classifier, Passive Aggressive Classifier, Multinomial Naïve Bayes, Support Vector Classifier, and Adaboost Classifier — are applied to the dataset.
- The process flow includes user registration, data collection, analysis, preprocessing, splitting, training, testing, and prediction. Each algorithm is instantiated, trained, and tested using the dataset. The performance metrics, including accuracy, precision, and recall, are used to evaluate the efficacy of each algorithm. The training and testing phases allow the algorithms to learn from historical data and make predictions on new instances.

Outcome:

- The results analysis reveals that the Random Forest Classifier outperforms other models, achieving an accuracy rate of 78%. This indicates that the Random Forest Algorithm is the most effective in classifying loan eligibility. The comparison of accuracies across all five algorithms is visualized through line charts, bar graphs, and a pie chart. The study concludes that this machine learning-based approach can significantly contribute to the efficient and accurate prediction of loan eligibility, benefiting both banks and customers.
- In conclusion, the project provides valuable insights into developing a robust loan prediction system using machine learning techniques, offering a promising solution for the challenges faced in the banking industry.

Article - 3

A STUDY ON MACHINE LEARNING ALGORITHM FOR ENHANCEMENT OF LOAN PREDICTION

- **Introduction:** The research focuses on the application of machine learning algorithms for enhancing loan prediction in the lending industry. The primary challenge addressed is predicting the risk of borrowers being unable to repay loans, crucial for lenders to make informed decisions. The study employs various machine learning techniques, with a particular emphasis on supervised classification. The introduction provides an overview of the lending industry's dynamics and emphasizes the significance of predicting customer repayment behavior.

Methodology:

- **Definition of Machine Learning:** The paper introduces machine learning as a subset of artificial intelligence, enabling computers to learn from previous tasks with minimal human intervention. It highlights the versatility of machine learning in automating tasks based on data-defined patterns or rules.

- **Types of Machine Learning:** The classification of machine learning into supervised, unsupervised, semi-supervised, and reinforcement learning is discussed. The focus is on supervised learning for loan prediction, where algorithms are trained using labeled data.

- **Importance of Machine Learning Algorithms:** The significance of machine learning algorithms in constructing predictive models using historical data is emphasized. The potential applications extend beyond credit risks to include early payment opportunities and other financial risks.

- **Dataset:** The dataset used for the project is described, consisting of training and testing datasets with 13 columns. These columns include essential attributes such as Loan_ID, Gender, Married, Education, Income details, Credit History, and Loan_Status.

- **Algorithm Used in Loan Prediction:** The chosen algorithms for the supervised classification problem are outlined, including Logistic Regression, Decision Tree, and Random Forest. The default hyperparameter values are utilized, and the paper mentions the possibility of using other models like XGBoost and CatBoost.

- **Steps Involved in Model Development:** The methodology section details the steps involved in developing the loan prediction model:
    1. Importing necessary libraries (e.g., pandas, NumPy, matplotlib, seaborn, sklearn).
    2. Loading and inspecting the dataset.
    3. Handling missing values.
    4. Analyzing and visualizing data through graphs.
    5. Encoding numeric data for training.
    6. Projecting heatmap to show feature correlations with the target variable.

Outcome:

- The results section presents the evaluation of the model using three algorithms: Logistic Regression, Decision Tree, and Random Forest. Logistic Regression outperforms the others with an evaluation accuracy of 89.7059%, while Decision Tree achieves 85.4054%, and Random Forest attains 77.4566%. The conclusion suggests that Logistic Regression is the best algorithm for loan prediction using machine learning, considering factors such as credit history, income, and demographic attributes. The findings from the test data analysis provide insights into the characteristics of loan applicants that influence approval or rejection. The conclusion emphasizes the importance of preventing defaults and highlights the need for financial institutions to consider various factors in the lending decision-making process.

Article - 4

Loan Prediction using Machine Learning Algorithms

- **Introduction:**The paper titled "Loan Prediction using Machine Learning Algorithms" addresses the increasing number of loan applications in India and the challenges faced by banks in determining the creditworthiness of applicants. The authors emphasize the importance of predicting whether a customer can repay the loan within the given time frame. The goal is to automate and streamline the loan approval process using machine learning techniques.

- The introduction covers the significance of loan distribution for banks, the challenges in identifying deserving applicants, and the potential benefits of a Loan Prediction System. The authors highlight the use of exploratory data analysis to address the loan approval problem. The key focus is on determining whether a loan should be approved for a particular individual or organization.

Methodology:

- The methodology section outlines the data set used, which is collected from the banking sector and presented in ARFF format. The paper utilizes 12 attributes, including gender, marital status, education qualification, income, and more. The data is processed through a machine learning model, involving training and testing phases.
- The Loan Prediction Methodology is illustrated, emphasizing the feature selection process to reduce input variables. The authors employ three machine learning classification models: Decision Tree, Logistic Regression, and Random Forest. Each model's brief description and accuracy are provided. Additionally, the paper discusses data pre-processing to handle values that may cause errors.

Outcome:

- The authors present the results of their exploratory data analysis, highlighting key insights such as the distribution of applicants based on gender, marital status, dependents, and other factors. The paper discusses the correlation between variables, pointing out that applicant income and loan amount, as well as credit history and loan status, are the most correlated.
- The machine learning models, Decision Tree, Logistic Regression, and Random Forest, are evaluated based on their accuracy. The Decision Tree model achieves 77% accuracy, Logistic Regression attains 78.91% with a confidence factor of 1.0, and Random Forest reaches 80.20% accuracy.

Article - 5

Analysis of Loan Availability using Machine Learning Techniques

- **Introduction:**The project focuses on analyzing loan availability using machine learning techniques, with a specific emphasis on the banking system. The primary goal is to develop a predictive model for identifying potential loan defaulters, thereby reducing a bank's Non-Performing Assets and enhancing profit margins. The logistic regression model is employed as a critical tool for predictive analytics. The dataset used for analysis is sourced from Kaggle, encompassing variables such as checking account details, customer personal attributes, age, objective, credit score, credit amount, and credit period.

Methodology:

- The research employs various machine learning models to assess and compare their performance in predicting loan availability. The models include Logistic Regression, Support Vector Machine (SVM), Decision Trees, Random Forest, Linear Models (LM), XGBoost Classifier, K-Nearest Neighbors (KNN), and Naive Bayes. Each model is evaluated based on accuracy scores, and a comparative analysis is conducted. The logistic regression model stands out as it considers a comprehensive set of variables, providing better accuracy in predicting loan outcomes. The study also presents a block diagram illustrating the different phases of the prediction process, including data cleaning, processing, and model testing on test data.

Outcome:

- The experimental analysis reveals that the Logistic Regression model achieves the highest accuracy (0.785) among the various machine learning models considered. This indicates that the logistic regression approach is effective in identifying potential loan defaulters, considering both checking account details and customer personal attributes. The research suggests that banks should not solely rely on a customer's wealth but also consider other characteristics in credit decisions and predicting loan defaulters. The model's accuracy in forecasting loan availability makes it a promising tool for the banking industry, offering a reliable and efficient means of evaluating loan eligibility.

Article - 6

MACHINE LEARNING TECHNIQUES FOR RECOGNIZING THE LOAN ELIGIBILITY

- **Introduction:**
- In the realm of modernization in engineering, our project focuses on leveraging machine learning techniques for loan eligibility prediction. Loans, being a crucial aspect of banking, necessitate a meticulous evaluation of various factors such as marital status, credit history, and gender. Manual analysis of loan predictions can be cumbersome and costly, prompting the need for an automated system.
- Our aim is to develop a predictive model that swiftly determines whether an individual is eligible for a loan. This not only benefits the banking staff but also provides customers with immediate eligibility analysis. The project utilizes machine learning algorithms, including logistic regression, decision tree, and random forest, to enhance the accuracy and efficiency of loan eligibility predictions.

Methodology:

- The dataset is divided into training and testing sets, comprising essential parameters like gender, marital status, education, and income. Exploratory data analysis, including a heatmap to reveal relationships between variables, guides the model development. The three chosen machine learning algorithms are implemented: logistic regression, decision tree, and random forest.
- ***Logistic Regression:*** This algorithm, a widely-used supervised learning method, predicts a categorical outcome based on independent variables. The logistic regression model in our project calculates probabilities, making it suitable for binary outcomes such as loan approval (Yes/No).
- ***Decision Tree:*** Decision trees visually represent decision-making processes based on features present in the dataset. The CART algorithm is employed for tree construction, and information gain guides attribute selection. Decision trees offer insights into the decision rules influencing loan eligibility.
- ***Random Forest:*** An ensemble learning algorithm, random forest, combines multiple decision trees to enhance predictive accuracy. By utilizing a diverse set of uncorrelated models, random forest minimizes overfitting and improves overall performance.

Outcome Analysis:

- After implementing the three machine learning algorithms, we analyze the results to determine their effectiveness in predicting loan eligibility.
- **Logistic Regression:** Achieves a mean validation accuracy of 80.78%, showcasing its suitability for loan prediction.
- **Decision Tree:** Yields a mean validation accuracy of 70.51%, providing valuable insights but with lower accuracy compared to logistic regression.
- **Random Forest:** Attains a mean validation accuracy of 79.79%, positioning it as a competitive model for loan eligibility prediction.

Article - 7

Prediction for Loan Approval using Machine Learning Algorithm

- **Introduction:** The project revolves around predicting loan approval using a machine learning algorithm. In the banking system, loans play a pivotal role in generating income, making it crucial for banks to assess the risk of default. The study aims to minimize non-performing assets by accurately predicting potential loan defaulters. Previous research has explored various methods for controlling loan default, emphasizing the importance of accurate predictions for profit maximization. The focus is on predictive analytics, involving data collection, cleaning, and performance evaluation. The study concludes that the Naïve Bayes model outperforms other models in loan forecasting.

Methodology:

1. **Motivation:** The motivation behind the project lies in the significance of loan approval for banking organizations. It highlights the challenges in predicting the likelihood of loan repayment and how machine learning can enhance the accuracy of such predictions.
2. **Literature Survey:** The literature review provides an overview of existing research in the field, citing relevant studies and their findings. It covers topics such as loan approval prediction based on machine learning approaches, exploration of machine learning algorithms for loan sanctioning processes, and the use of decision trees and random forests in loan prediction.
3. **Problem Definition:** The project addresses the challenges faced by banks, housing finance companies, and NBFCs in validating the eligibility of customers for various types of loans. It proposes an automated solution using machine learning algorithms to streamline the loan eligibility process based on customer details.
4. **Proposed Model:** The system architecture involves data collection, pre-processing, model selection, classification, and result determination. The proposed algorithm includes steps such as loading data, determining training and testing data, data cleaning, and applying machine learning models like SVM and Naïve Bayes.
5. **System Features:** The key features of the system include data collection, data cleaning, model selection, data verification, classification, and report delivery. These features collectively contribute to the accurate prediction of loan approval or rejection.

Outcome:

- The project concludes that the Naïve Bayes model demonstrates high efficiency and accuracy in predicting loan approval. The system successfully calculates and predicts the loan's safety, providing a reliable tool for bankers to make informed decisions. The outcome is a well-designed system that accurately assesses the risk associated with loan approval, contributing to the overall efficiency of the banking process

Article - 8

Prediction of Loan Approval in Banks using Machine Learning Approach

- **Introduction:** In this study, we propose a machine learning model for predicting the loan approval or rejection status based on various factors such as credit score, loan amount, tenure, and employment type. Our system is designed to be efficient and accurate in making predictions. We evaluate the performance of our system using various metrics, including accuracy, confusion matrix, and area under the ROC curve. We believe that our proposed model can provide valuable insights for financial institutions to make informed decisions regarding loan approval.
- We utilize the Naïve Bayes model for our analysis, as it is known for its accuracy and simplicity. The Naïve Bayes model is a probabilistic classifier based on applying Bayes' theorem with strong (naive) independence assumptions between the features.
- The accuracy of our system can be enhanced by incorporating more relevant features, performing a thorough data cleaning process, and tuning the hyperparameters of the Naïve Bayes model.

- To predict the loan approval or rejection status, we employ the following methodology:

1. Data Collection:
    1. Collect the data set of loan applications, which includes features such as credit score, loan amount, tenure, and employment type.
    2. Use real-world data sets, which are widely available in online sources like Kaggle, to ensure the model's robustness and applicability.
2. Data Preprocessing:
    1. Clean the data by handling missing values, removing duplicates, and transforming categorical variables into numerical form using techniques like one-hot encoding.
    2. Standardize the features by scaling the values to a common range to avoid any bias introduced by the feature scaling process.
3. Model Selection and Training:
    1. Use the Naïve Bayes model for the analysis, as it is known for its accuracy and simplicity.
    2. Split the data set into training and testing subsets using stratified sampling or other suitable techniques to ensure a representative and balanced split.
    3. Train the model using the training data and calculate the performance metrics using the testing data.

Methodology

1. Model Evaluation:
    1. Calculate the accuracy of the model using the testing data.
    2. Compute the confusion matrix to assess the performance of the model on the basis of the predicted class versus the actual class.
    3. Measure the area under the ROC curve (AUC-ROC) to evaluate the model's ability to distinguish between different classes.
2. Model Optimization:
    1. Fine-tune the hyperparameters of the Naïve Bayes model using techniques like grid search or random search to achieve optimal model performance.
    2. Consider incorporating additional features that may be relevant to the loan approval or rejection status, such as co-applicant's credit score, education level, or debt-to-income ratio.
3. Model Deployment:
    1. Deploy the optimized model for real-time loan approval or rejection status prediction using the selected features.
    2. Ensure that the deployed model remains up-to-date by regularly updating it with the latest data and retraining the model accordingly.
4. Interpretation of Results:
    1. Interpret the model's predictions by analyzing the impact of individual features on the prediction outcome.
    2. Utilize the model's insights to develop targeted strategies for improving the financial health of the customers and, consequently, enhancing the profitability of the financial institution.

Outcome:

The overall success of a loan approval or rejection status prediction model can significantly vary depending on various factors such as the accuracy of the data used for model training, the reliability of the Naïve Bayes model, and the extent to which the model can adapt to new data and situations.

To enhance the predictive capabilities of the model, it is crucial to:

1.Continuously collect and update comprehensive data on loan applicants, including demographic information, credit history, and other relevant factors.

2.Regularly monitor and evaluate the performance of the model to identify areas of improvement and adjust the model accordingly.

3.Incorporate additional features and attributes that may contribute to a more accurate assessment of a loan applicant's creditworthiness.

In conclusion, the predictive model for loan approval or rejection can be highly effective when properly managed and maintained. By investing time and resources into developing and refining the model, financial institutions can enhance their overall credit evaluation processes and potentially improve the efficiency and accuracy of loan approval decisions.

Article - 9

Customer Loan Prediction Using Supervised Learning Technique

- **Introduction:**
- Customer loan prediction is a critical aspect for retail banks, impacting their core business of loan circulation. This study addresses the lifetime issue faced by banks in determining the eligibility of loan applicants. The objective is to semi-automate the loan acceptance process in real-time based on customer details provided during online applications. The key variables considered include Gender, Marital Status, Education, Number of Dependents, Income, Loan Amount, Credit History, and others. The aim is to implement a machine learning model to classify loan applicants and predict whether a loan would be approved. The study focuses on using the Random Forest classification method for its accuracy in classifying loan candidates.

Methodology:

- The research employs supervised learning techniques and various classification models to predict customer loan approval. The dataset, obtained from Kaggle, consists of 614 rows and 13 columns, with one column representing the target attribute. The literature survey explores the use of Random Forest, Decision Trees, Support Vector Machines (SVM), Logistic Regression, and K-Nearest Neighbors (KNN) in similar contexts.
- The proposed model involves preprocessing the data using techniques such as MinMax scaling to normalize the data and handle missing values. Feature selection and engineering are applied to enhance machine learning model performance. The chosen machine learning models include Decision Trees, Random Forest, SVM, Logistic Regression, and KNN.

Outcome:

- The experiment evaluates the performance of each model using metrics such as accuracy, precision, recall, and F1-score. The results indicate that the Random Forest model achieves the highest accuracy among the tested models. Confusion matrices provide a detailed analysis of the model's performance, showcasing its ability to correctly classify positive and negative instances.

Article - 10

A Comparative Study on Loan Eligibility

- **Introduction:**
- The banking sector relies significantly on the distribution of loans, a core business function contributing to a substantial portion of a bank's assets. The process of determining loan eligibility involves a complex and time-consuming verification process. This paper explores the application of machine learning algorithms, specifically Logistic Regression, Random Forest, Support Vector Machine, and XGBoost, to predict loan eligibility. The aim is to automate and expedite the validation process, providing a quick and efficient means of identifying deserving loan applicants.

Methodology:

1. Data Collection:

1. The heart of machine learning is data. The dataset used in this study is obtained from Kaggle, providing the necessary information for training predictive models.

2. Data Pre-processing:

1. Cleaning the dataset involves handling null values, visualizing data through graphs, applying log transformation to specific attributes, engineering new features (e.g., Total_Income), and addressing categorical attributes using Label Encoding.

3. Building and Training the Model:

1. The dataset is split into training and testing sets (80% training, 20% testing). Four machine learning models, namely Logistic Regression, Random Forest Classifier, XGBoost Classifier, and Support Vector Machine, are imported using the Scikit-learn library. K-fold Cross Validation is employed for accurate model training and testing.

4. Models Used:

1. Logistic Regression: A classification algorithm suitable for discrete target variables.
2. Random Forest Classifier: A supervised learning algorithm utilizing ensemble learning for classification and regression.
3. XGBoost Classifier: A decision-tree-based ensemble machine learning algorithm employing a gradient boosting framework.
4. Support Vector Machine: A model aiming to find a hyperplane in an N-dimensional space to distinctly classify data points.

5. Testing and Comparison:

1. Evaluation involves K-fold Cross Validation and Confusion Matrix analysis. Confusion Matrix provides a holistic view of the model's performance by comparing actual and predicted target values.

Outcome:

- The results, obtained through K-Fold Cross Validation, reveal that Logistic Regression demonstrates the highest accuracy among the models studied. The Confusion Matrix and Classification Report for Logistic Regression further support its effectiveness. This suggests that Logistic Regression can serve as a robust and accurate model for predicting loan eligibility, offering banks an efficient alternative to the traditional, time-consuming process.

Article - 11

Loan Prediction using Decision Tree and Random Forest

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Introduction:

- In India, the increasing number of loan applications poses a challenge for banks to efficiently analyze and predict the likelihood of repayment. This paper addresses the issue of loan approval prediction using machine learning techniques, specifically Decision Tree and Random Forest. The focus is on exploring the background and credibility of loan applicants, aiming to streamline the approval or rejection process through exploratory data analysis.

Methodology:

1. **Data Set:**
    1. A dataset from the banking sector, presented in ARFF format suitable for Weka, is utilized. It includes 12 attributes such as gender, marital status, income, etc.
2. **Data Pre-processing:**
    1. Data pre-processing involves handling redundant, incomplete, or missing values, ensuring a clean dataset. The data is split into training and testing sets for model development.
3. **Loan Prediction Methodology:**
    1. The model's working involves data collection, pre-processing, and the application of machine learning methods. Feature selection is performed using supervised and unsupervised methods to enhance the prediction accuracy.
4. **Exploratory Data Analysis:**
    1. Key insights from exploratory data analysis include observations such as the correlation between salary and loan approval, the influence of education on approval, and the impact of marital status and the number of dependents.
5. **Machine Learning Methods:**
    1. Two classification models, Decision Tree and Random Forest, are employed for predicting loan approval. Decision Tree is implemented using the J48 classifier, and Random Forest experiments involve different parameters such as the number of trees and variables.

Outcome:

- The application of Decision Tree and Random Forest models yields promising results for loan prediction. The models are trained with a diverse dataset, and the accuracy is analyzed with varying parameters. The use case diagram illustrates the working of the model, encompassing data collection, pre-processing, training, testing, and result analysis. The feature selection process enhances the model's effectiveness.

Article - 12

MACHINE LEARNING TECHNIQUES FOR RECOGNIZING THE LOAN ELIGIBILITY

- **Introduction:** The paper explores the application of machine learning techniques in predicting loan eligibility, emphasizing the significance of accurate predictions for banking institutions. Loans, being a crucial source of income for banks, necessitate careful evaluation of a borrower's creditworthiness. The study focuses on automating the loan prediction process to enhance efficiency and reduce costs. Various parameters such as marital status, credit history, and gender are considered for analysis. The goal is to develop a model that quickly assesses eligibility, benefiting both bank staff and customers.

Methodology:

- The research involves the use of three machine learning algorithms—logistic regression, decision tree, and random forest. These algorithms are applied to a dataset divided into training and testing sets. Logistic regression, a supervised learning algorithm, is employed for its ability to predict categorical outcomes. Decision tree, a graphical representation of decision rules, and random forest, an ensemble learning algorithm, are also considered. The dataset, containing parameters like gender, marital status, and education, is analyzed using these algorithms. The study includes a heatmap to visualize the correlation between features.

Outcome:

- The results of the analysis indicate that logistic regression outperforms the other algorithms with an accuracy of 80.78%, followed closely by random forest at 79.79%, and decision tree with 70.51%. The study concludes that logistic regression is the most suitable algorithm for loan eligibility prediction. The findings suggest the potential inclusion of other machine learning algorithms for further comparison, such as XGBoost. The trained model provides accurate and efficient loan eligibility assessments, minimizing manual work and ensuring fair evaluations based on various parameters.

Article - 13

Predict Loan Approval in Banking System Machine Learning Approach for Cooperative Banks Loan Approval

- **Introduction:**
- In this project, the focus is on leveraging machine learning techniques to predict the approval or rejection of loans in cooperative banks. With the common issue of loan defaulters causing significant losses to banks, the need for a robust system to evaluate creditworthiness becomes imperative. The paper proposes the use of various machine learning algorithms on bank credit data to extract crucial information. The ultimate goal is to provide organizations with a reliable tool for making informed decisions on loan requests.

Methodology:

- The methodology involves employing different machine learning algorithms, categorized into supervised learning, to analyze the labeled bank credit data. The supervised learning algorithms include neural networks, discriminant analysis, Naive Bayes, K-Nearest Neighbor, linear regression, ensemble learning, and decision trees. The dataset is divided into training and testing sets for model development and evaluation.
- The steps in the methodology are as follows:

1. **Data Collection:** Gather loan data from multiple sources, focusing on cooperative banks.
2. **Data Preparation:** Understand and analyze the relationship among different features in the dataset.
3. **Algorithm Training:** Train various classification algorithms using the labeled dataset.
4. **Algorithm Testing:** Evaluate the performance of the trained algorithms on the test dataset.
5. **Feature Extraction:** Identify the most important features influencing creditworthiness.

Outcome:

- The experiment revealed the effectiveness of different machine learning algorithms, with most achieving accuracy rates between 76% and over 80%. Features influencing creditworthiness were identified, and a predictive model using linear regression was formulated. Notably, the Nearest Centroid and Gaussian Naive Bayes algorithms performed slightly less credibly.
- In conclusion, the project establishes a machine learning approach for predicting the creditworthiness of customers applying for loans in cooperative banks. The developed model provides a tool for automating the bank's risk assessment process, aiding in making informed decisions regarding loan approvals.

Article - 14

LOGISTIC REGRESSION BASED LOAN APPROVAL PREDICTION

- **Introduction:** The rapid growth in the banking sector has led to an influx of loan applications, making the process of identifying suitable candidates for loan approval challenging. This paper proposes a model that utilizes machine learning techniques, specifically Logistic Regression, to predict the approval or rejection of a loan application. By training the model on historical loan data, it aims to automate the validation process and assist banks in making informed decisions.

Methodology:

- The proposed model employs Logistic Regression, a popular supervised learning algorithm, suitable for predicting categorical dependent variables. In this case, the output is binary—either approval (1) or rejection (0). Logistic Regression fits an "S"-shaped logistic function, providing probabilistic values between 0 and 1. The sigmoid function maps real values to probabilities, and a threshold value determines the classification. The model is trained on various input variables, including gender, marital status, dependents, education, applicant income, loan amount, loan amount term, credit history, and property area.

Outcome:

- The experimental results demonstrate the effectiveness of the Logistic Regression model in predicting loan approval. A user interface is designed for inputting applicant data, and the model outputs a binary result, indicating whether the loan is approved (1)or not (0). The implementation showcases the potential for efficient decision-making in loan approval processes. The conclusion emphasizes the significance of Logistic Regression and suggests exploring the integration of other techniques for improved performance in the banking domain.

Article - 15

ML Based Loan Approval Prediction System A Novel Approach

- **Introduction:** The paper titled "ML Based Loan Approval Prediction System: A Novel Approach" addresses the significance of loan approval systems in banks, emphasizing the need to reduce losses and approve loans only for eligible customers capable of repayment. Despite previous studies' good performance, the authors aim to enhance accuracy. The study explores various machine learning algorithms, including Logistic Regression, Decision Tree, Random Forest, K Nearest Neighbors, Artificial Neural Network, Naive Bayes, Adaboost, and Voting Classifier, for predicting loan approval.

Methodology:

- The proposed algorithm employs a range of machine learning algorithms for loan approval prediction. The algorithms include Logistic Regression, Decision Tree, Random Forest Classifier, K-Nearest Neighbor, Naïve Bayes, Adaboost, Linear SVM, Polynomial SVM, and Wavelet SVM. Each algorithm is described briefly, emphasizing their application in loan approval prediction. The methodology involves training the models using relevant datasets, preprocessing, and implementing these algorithms to predict loan approval.

Outcome:

- Simulation results are presented to showcase the performance of different machine learning algorithms in predicting loan approval. The comparative analysis highlights the proposed study's superior performance, achieving accuracy rates of 86%, 74%, 86%, and 86% for Logistic Regression, Decision Tree, Support Vector Machine (RBF), and Naive Bayes, respectively. The study concludes by emphasizing the potential efficiency and accuracy improvements the proposed system offers in the loan approval process.

Article - 16

PREDICTION OF CUSTOMER LOAN ELIGIBILITY USING RANDOM FOREST ALGORITHM

- **Introduction:** The paper titled "Prediction of Customer Loan Eligibility Using Random Forest Algorithm" explores the application of predictive analytics to address the challenge of forecasting loan defaulters. The authors utilize data collected from Kaggle for studying and prediction purposes. The focus is on employing Random Forest models and evaluating their performance based on measures like sensitivity and specificity. The study aims to identify eligible loan applicants efficiently by assessing their likelihood of default.

Methodology:

- The proposed system targets the prediction of loan approval for customers in finance companies. It involves creating a robust model using machine learning algorithms, specifically the Random Forest algorithm. The authors outline the steps of preprocessing, Exploratory Data Analysis (EDA), Feature Engineering, and Model Selection. The key goal is to build a model that takes various customer details as input, such as marital status, gender, education, income, credit history, etc., to determine loan eligibility. The model is then trained using a dataset, and a web application is suggested for user interface interaction.

Outcome:

- The results showcase the efficiency of the Random Forest model in predicting loan eligibility. The authors present a dataset containing attributes like marital status, gender, education, income, loan amount, credit history, etc. The model is trained on this dataset, achieving a 77% accuracy rate. The system allows users to upload a test dataset for eligibility prediction, providing results with normalized values and predictions of eligibility (Y) or non-eligibility (N). Performance metrics, including accuracy, precision, recall, and FSCORE, are graphically presented, emphasizing the model's effectiveness in automating the loan approval process.

Article - 17

Loan Default Identification and its Effect

- **Introduction:** The paper titled "Loan Default Identification and its Effect" addresses the challenges faced by the banking sector in managing loan defaults. With the increasing number of loan applications, banks must ensure that loans are granted only to genuine customers to protect their limited assets. The paper proposes a solution to reduce uncertainty in loan approval by leveraging machine learning techniques. Specifically, the authors focus on mining large datasets of past loan data to train a machine learning model that can accurately predict loan approval. The primary goal is to approve loans only for customers who are likely to repay them.

Methodology:

- The implementation of the project involves two main parts: data analysis and data cleaning. The authors emphasize the importance of selecting relevant features through feature selection techniques, handling null values through imputation, and addressing outliers to improve the quality of the dataset. The machine learning model is trained using logistic regression and random forest algorithms. Logistic regression generates probabilities between 0 and 1, offering a nuanced prediction. On the other hand, random forest, as an ensemble of decision trees, provides flexibility and robustness in predicting loan defaults.
- The dataset attributes include customer ID, loan amount, loan term, interest rate, installment amount, loan grade, annual income, credit history, property area, and loan status. The authors perform feature selection, null value imputation, and outlier handling to enhance the dataset's quality. The training process involves logistic regression and random forest algorithms.

Outcome:

- The model's accuracy in predicting loan defaults is reported at 61%, and the Return on Investment (ROI) is calculated to assess the model's effectiveness. The ROI is significantly improved after applying the model, indicating its positive impact on identifying potential defaulters. The authors conduct a grade-wise analysis of ROI, showing that the model positively influences loan approval for certain grades.
- In conclusion, the proposed model demonstrates efficiency in automating the loan approval process, reducing the risk of defaults, and improving the financial performance of banks. The authors suggest future integration with automatic processing systems and ongoing updates to adapt to new testing data.

Article - 18

Comparative Analysis of Bank Loan Defaulter Prediction Using Machine Learning Techniques

- Introduction: The contemporary banking sector faces significant challenges in assessing and managing risks associated with loan approvals. With the increasing volume of transactions and available data, the need for effective risk evaluation has become crucial. This paper aims to explore the characteristics of loan applicants and proposes a comparative analysis of three machine learning models—Random Forest, Naive Bayes (Gaussian, Multinomial, and Bernoulli models), and Support Vector Machine (Linear, Gaussian RBF, and Polynomial kernels). The objective is to predict whether a customer is likely to default on a bank loan.

Methodology:

- The study utilizes a dataset from Kaggle, comprising 983 bank loan samples with 13 parameters. The data preprocessing involves handling missing values and converting categorical variables to continuous ones. The dataset is split into a 70% training set and a 30% testing set. Three machine learning models are employed for prediction:

1. Random Forest: A supervised learning algorithm that generates decision-making trees.
2. Naive Bayes: Utilizing Gaussian, Multinomial, and Bernoulli models based on Bayesian theorem assumptions.
3. Support Vector Machine: Employing Linear, Gaussian RBF, and Polynomial kernels to classify data points.

Outcome:

- The evaluation parameters, including classification accuracy, precision, recall, and F1-Score, are analyzed for each machine learning model. The results indicate that SVM with a Linear kernel outperforms other models in terms of accuracy. Precision, recall, and F1-Score comparisons reveal the strengths and weaknesses of each model. Additionally, feature importance is assessed using the Random Forest algorithm, highlighting credit history as a crucial determinant in loan prediction.
- In conclusion, this study provides insights into the effectiveness of different machine learning models in predicting loan approval outcomes. The SVM model with a Linear kernel demonstrates superior performance, emphasizing the significance of credit history in the decision-making process. The findings contribute to the ongoing efforts in developing efficient loan prediction models for the banking sector.

Article - 19

Machine Learning Algorithm to Predict Fraudulent Loan Requests

- **Introduction:**
- The study focuses on developing a predictive model for fraudulent loan requests in the banking sector using machine learning algorithms. With the increasing number of individuals applying for bank credits, determining which loan applications should be accepted or rejected becomes a challenging task for banking organizations. The paper explores the use of six machine learning algorithms, namely Decision tree, Support vector machine, Random forest, K nearest neighbors, Ada-Boost, and Logistic regression, to predict fraudulent loan requests.

Methodology:

- The researchers collected data from an online platform, and the dataset includes various attributes related to loan requests. The study involves data visualization, preprocessing, and the implementation of six different classification algorithms. These algorithms include Support Vector Machine (SVM), Decision Tree, Logistic Regression, Ada-Boost, Random Forest, and K-Nearest Neighbors (KNN). The evaluation metrics used include accuracy, precision, F1-score, recall, and support.

Outcome:

- The results indicate that the K-Nearest Neighbors algorithm outperformed the other five machine learning approaches, achieving an accuracy of 83.75%. The precision, F1-score, and recall values for KNN also demonstrate its effectiveness in predicting fraudulent loan requests. The study provides insights into the importance of machine learning in enhancing the decision-making process for loan approval in the banking sector, ultimately contributing to fraud detection and risk mitigation.

Article - 20

Loan Analysis Predicting Defaulters

- **Introduction:**
- The project titled "Loan Analysis Predicting Defaulters (LAPD)" addresses the challenges faced by the banking sector, particularly in the aftermath of the COVID-19 pandemic. The sudden economic downturn resulted in a surge of loan defaults, prompting the need for a robust credit risk scoring model. LAPD aims to leverage machine learning techniques to create an effective model for predicting loan defaults, thereby minimizing credit risk and preventing losses for financial institutions.

Methodology:

- The methodology of LAPD involves a comprehensive approach, combining artificial intelligence and data science. The project utilizes a dataset sourced from Kaggle, encompassing loan data from 2007 to 2015. The data preprocessing phase involves techniques such as variable name adjustments, label encoding, and handling imbalanced datasets using SMOTE and SMOTE ENN.
- Various classification algorithms, including Logistic Regression, Decision Tree, Ada Boost, and Random Forest, are applied to build models. The dataset balancing techniques significantly contribute to improving model accuracy. The evaluation of different algorithms demonstrates that Random Forest with SMOTE ENN achieves the highest accuracy of 92%.
- The integration of the machine learning model into a user-friendly web application is facilitated by the Flask framework. This allows end-users, especially banking professionals, to easily access and utilize the predictive capabilities of LAPD. The website includes features such as login, registration, and a prediction calculator for clients.

Outcome:

- The outcome of LAPD is a highly accurate loan default prediction model integrated into a web application. The developed model and website provide a practical solution for financial institutions to strengthen their loan sanctioning systems, reduce rejection rates, and mitigate the impact of loan defaults. The project's success opens avenues for future enhancements, including the integration of Natural Language Processing (NLP) chatbots for improved interactivity and the exploration of mobile applications for broader accessibility. Additionally, widening the dataset could further enhance the model's predictive capabilities.
- In conclusion, LAPD stands as a promising initiative in leveraging data science and machine learning to address critical challenges faced by the banking sector, particularly in times of economic uncertainty.

Article - 21

Accuracy Prediction for Loan Risk Using Machine Learning Models

- **Introduction:**
- The research article titled "Accuracy Prediction for Loan Risk Using Machine Learning Models" focuses on the application of various machine learning models to predict the likelihood of loan default. The importance of extending credit efficiently is highlighted, emphasizing the need for accurate predictions to aid banks in decision-making. The study employs R language for model implementation and evaluation. Machine learning concepts, including supervised learning and the categories of classification and regression, are introduced. The introduction also provides an overview of R language, emphasizing its role in statistical computing and data analysis.

Methodology:

- The methodology section outlines the data set and features used in the experiment, including 13 attributes such as gender, marital status, education, income, loan amount, credit history, etc. The machine learning models applied for prediction and their corresponding tuning parameters are presented. The models include Decision Tree, Linear Model, Random Forest, Neural Network, Support Vector Machine (SVM), Extreme Learning Machine, and others. The accuracy measure is defined, considering true positives, true negatives, false positives, and false negatives. The Caret Package in R is mentioned for evaluating the accuracy of machine learning algorithms.

Outcome:

- The results section presents the accuracy outcomes for each model over five experimental runs. The accuracy percentages are provided for Decision Tree, Linear Model, Neural Network, Random Forest, SVM, Bagged Cart, Tree Model for Genetic Algorithm, Model Tree, Extreme Learning Machine, Multivariate Adaptive Regression Splines, and Bayesian Generalized Linear Model. The experimental results consistently show that the Tree Model for Genetic Algorithm performs the best among all models for predicting loan outcomes. Visual representations of accuracy across different runs (Figures 2 to 6) further support the conclusion. The section emphasizes the importance of accuracy in decision-making for financial organizations dealing with loans.
- The article concludes by summarizing the findings and highlighting the significance of choosing an appropriate machine learning model for accurate loan risk prediction. The references section provides a list of works cited in the research article.

Article - 22

An improved light gradient boosting machine algorithm based on swarm algorithms for predicting loan default of peer-to-peer lending

- **Introduction:** The proposed method enhances the accuracy of loan default prediction by combining the strengths of Swarm Algorithms and LightGBM algorithm. Swarm Algorithms, inspired by the collective behavior of social insects, are particularly effective in solving optimization problems with constraints. On the other hand, LightGBM is a high-performance gradient boosting framework that provides an efficient solution for gradient boosting decision tree (GBDT), gradient boosting random forest (GBRT), and other machine learning algorithms. The integration of Swarm Algorithms and LightGBM can significantly improve the predictive performance of loan default risk, ensuring the efficient and effective allocation of financial resources.

Methodology:

- The research methodology adopted in this study includes a systematic literature review to identify the relevant research and methodologies in the field of swarm algorithms and machine learning for predicting loan default.
- A hybrid methodology combining Swarm Algorithms and LightGBM is proposed to enhance the accuracy of loan default prediction. The Swarm Algorithms are employed to find the optimal solution in the parameter tuning process, while LightGBM is used to build the final prediction model.

Outcome:

- The proposed hybrid methodology is evaluated on a dataset containing loan default information. The results indicate that the combination of Swarm Algorithms and LightGBM achieves higher accuracy in predicting loan default risk compared to the use of Swarm Algorithms alone or LightGBM alone.
- The proposed approach effectively improves the accuracy of loan default prediction by integrating the strengths of Swarm Algorithms and LightGBM algorithm. The application of this methodology in the real-world financial sector can lead to more efficient and effective management of financial resources, ultimately benefiting both the borrowers and the lenders.

Article - 23

Predicting Bank Loan Risks Using Machine Learning Algorithms

- Introduction: The research titled "Predicting Bank Loan Risks Using Machine Learning Algorithms" by Maan Y. Alsaleem and Safwan O. Hasoon explores the crucial role of bank loans in the development of banks' investment business. The authors address the risk-related issues associated with bank loans and highlight the challenges posed by the tremendous amount of borrower data in the era of computerization. The introduction emphasizes the significance of utilizing data mining algorithms for loan classification and decision-making.

Methodology:

- The study employs various machine learning algorithms to classify bank loan risks, comparing their performance based on standard criteria. The algorithms considered include Decision Tree J48 (DT J48), Random Forest, BayesNet, NaiveBayes, and Multilayer Perceptron. The authors provide a detailed overview of each algorithm's methodology, such as the decision tree construction in DT J48, the random forest approach, Bayes's theorem application, and the mathematical model of the Multilayer Perceptron.

Outcome:

- The research evaluates and compares the performance of the machine learning algorithms using a dataset titled "German Credit data." The dataset is preprocessed and divided into training and testing subsets. Performance measures such as Root Relative Squared Error, Relative Absolute Error, Kappa Statistic, and ROC curves are employed for analysis. The Multilayer Perceptron algorithm emerges as the most accurate among the considered algorithms, outperforming DT J48, BayesNet, NaiveBayes, and Random Forest in predicting bank loan risks. The study concludes by affirming the suitability of the proposed algorithms for this purpose with acceptable accuracy rates, emphasizing the superiority of neural networks, specifically the Multilayer Perceptron, in this context.

Article - 24

Fraud prediction in bank loan administration using decision tree

- **Introduction:** The article addresses the issue of fraud in bank loan administration, particularly the alarming rate of funds lost due to loan default. The consequences include bank closures, denied access to loans for potential beneficiaries, and job losses. The traditional methods of credit history judgment by humans are deemed inefficient in handling the large volume and variety of data associated with loan records. The article emphasizes the need for intelligent technology, specifically machine learning, to predict and prevent fraud in bank loan administration.

- **Methodology:**

The authors utilize a dataset of 5000 instances with 9 attributes, including age, sex, income, employment status, and loan-related information. Python programming language and Matlab 2017b are employed for fraud prediction using the decision tree method. The methodology involves features extraction, data pre-processing, and the use of Principal Component Analysis (PCA) for relevant features. Cross-validation is used to avoid overfitting, and the dataset is split into training and testing data. The decision tree algorithm is applied to predict fraud in bank loan administration, achieving an accuracy of 75.9%.

Outcome:

- The results indicate that machine learning, specifically the decision tree method, provides a reliable solution for fraud prediction in bank loan administration. The accuracy of 75.9% is achieved through the identification of hidden patterns in the dataset. The article concludes that false positives can be reduced using the decision tree method, offering financial institutions a dependable tool for scrutinizing loan applications. The study highlights the potential of machine learning in addressing the challenges of fraud in financial operations, contributing to the overall stability of the banking sector.