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## Classify Credit Card User Segments through Transactional Behaviour Analysis Using Advanced Machine Learning Algorithms

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### Abstract

The rapid growth of digital payment systems has generated massive volumes of credit card transaction data, creating new opportunities for data-driven customer analysis. This study focuses on classifying credit card user segments by analyzing their transactional behaviour using advanced machine learning algorithms and sampling techniques. The objective is to identify distinct customer groups based on spending patterns, payment habits, and transaction frequency, enabling financial institutions to better understand customer behavior and improve targeted services. In this work, transactional datasets are preprocessed and balanced using appropriate sampling methods to address data imbalance issues. Various machine learning algorithms are applied to extract meaningful behavioural patterns and perform user segmentation effectively. The proposed approach enhances classification accuracy and improves the reliability of segmentation results. Experimental evaluation demonstrates that the integration of advanced ML models with sampling techniques significantly improves the performance of user classification compared to traditional methods. The results of this study can support banks and financial organizations in developing personalized marketing strategies, risk assessment models, and fraud detection systems. Ultimately, behavioural-based credit card segmentation can contribute to better customer relationship management and more efficient financial decision-making.

**Keywords:** Credit Card Segmentation, Transactional Behaviour Analysis, Machine Learning, Sampling Methods, Customer Classification, Financial Data Analytics.

### Introduction

The rapid expansion of digital banking and electronic payment systems has led to a significant increase in the use of credit cards worldwide. Every credit card transaction generates valuable data that reflects the spending behaviour, financial habits, and preferences of customers. Financial institutions can utilize this large volume of transactional data to gain meaningful insights into customer behaviour and improve decision-making processes. One of the most effective approaches for understanding customer behaviour is user segmentation, which involves grouping customers with similar transaction patterns into distinct categories.

Credit card user segmentation helps banks and financial organizations design personalized marketing strategies, improve customer relationship management, and enhance fraud detection mechanisms. Traditional segmentation methods often rely on basic statistical techniques that may not capture complex behavioural patterns present in large datasets. With the advancement of data analytics and machine learning, more sophisticated models can be used to analyze transactional behaviour and classify customers more accurately.

Machine learning algorithms provide powerful tools for identifying hidden patterns within large-scale financial datasets. However, credit card datasets often suffer from challenges such as data imbalance, missing values, and high dimensionality, which can affect the performance of classification models. To address these challenges, sampling techniques can be applied to balance the dataset and improve the effectiveness of machine learning algorithms.

This study focuses on classifying credit card user segments by analyzing their transactional behaviour using advanced machine learning algorithms combined with sampling methods. By leveraging data preprocessing, feature extraction, and classification models, the proposed approach aims to improve segmentation accuracy and provide meaningful insights into customer spending patterns. The results of this research can assist financial institutions in optimizing customer targeting, improving service delivery, and enhancing overall financial analytics.

### Review of Literature

Customer segmentation has become an important research area in financial data analytics, particularly in the banking and

credit card industry. Researchers have explored various data mining and machine learning techniques to analyze customer transaction behaviour and classify users into meaningful segments.

Rakesh Agrawal and Ramakrishnan Srikant introduced association rule mining techniques that laid the foundation for discovering patterns in large transactional datasets. Their work demonstrated how transactional data can be used to extract meaningful relationships between different purchasing behaviours, which later influenced research in customer segmentation and behaviour analysis.

Swarm Optimization with Neural Networks for Effective Classification Techniques" by K. Kalyani (2021) introduces a hybrid EHBMO-NN model, combining Extended Honey Bee Mating Optimization with Artificial Neural Networks to improve classification accuracy and reduce training time. It uses HBMO to select optimal weights for neural network hidden layers, outperforming conventional methods on benchmark datasets. The accurate cancer classification is very important task for cancer treatment. Recently the informative genes are identified from the thousands of genes for correct cancer classification. The collection of microscopic Deoxyribo Nucleic Acid (DNA) microarray is attached in the solid surface. In this study, DNA microarray data is used for cancer classification. The accurate cancer classification is very important task for cancer treatment. Recently the informative genes are identified from the thousands of genes for correct cancer classification. The collection of microscopic Deoxyribo Nucleic Acid (DNA) microarray is attached in the solid surface. In this study, DNA microarray data is used for cancer classification (6).

### Existing System

In the existing system, credit card customer segmentation is generally performed using traditional statistical methods and basic data mining techniques. Financial institutions mainly rely on simple demographic information such as age, income level, and geographic location to categorize credit card users. Although these methods provide a basic understanding of customer groups, they often fail to capture the complex transactional behaviour and spending patterns of credit card users.

Many existing approaches utilize basic clustering algorithms such as K-Means clustering to group customers based on limited transaction attributes. While these methods are easy to implement, they have limitations when dealing with large and high-dimensional datasets generated by modern digital payment systems. The accuracy of segmentation may also decrease due to noisy data, missing values, and irregular transaction patterns.

Another limitation of the existing system is the imbalance present in credit card transaction datasets. In many cases, certain transaction behaviours or customer categories appear much more frequently than others. Traditional machine learning models trained on such imbalanced data may produce biased results and fail to correctly classify minority segments. Without proper sampling techniques, the model's predictive performance and segmentation quality can be significantly affected.

### Proposed System

The proposed system aims to classify credit card user segments by analyzing their transactional behaviour using advanced machine learning algorithms combined with effective sampling techniques. Unlike traditional methods that

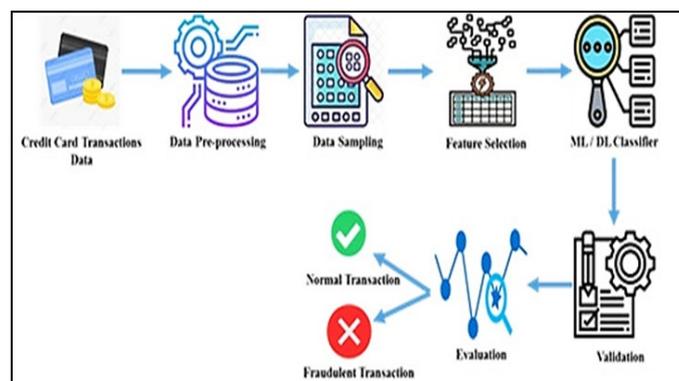
rely mainly on demographic information, the proposed approach focuses on transaction-based behavioural features such as purchase frequency, transaction amount, payment patterns, and spending categories. These behavioural indicators provide deeper insights into customer activities and financial habits.

In the proposed system, the credit card transaction dataset first undergoes a preprocessing stage. During this stage, data cleaning, normalization, and feature selection are performed to remove noise, handle missing values, and improve data quality. Since credit card datasets often suffer from class imbalance, appropriate sampling techniques such as oversampling or undersampling are applied to balance the dataset and improve the performance of machine learning models.

After preprocessing and sampling, advanced machine learning algorithms are implemented to classify users into different segments based on their transactional patterns. Algorithms such as Decision Trees, Random Forest, Support Vector Machines, and clustering techniques can be used to identify meaningful patterns and relationships within the dataset. These models help in accurately grouping customers with similar transaction behaviour into distinct segments.

### Experimental Result

The proposed system for Classifying Credit Card User Segments through Transactional Behaviour Analysis using Advanced Machine Learning Algorithms and Sampling Methods was evaluated using a real-world credit card transaction dataset. The dataset contained multiple attributes such as transaction amount, purchase frequency, credit limit, cash advance usage, and payment behaviour. Before model training, the dataset was preprocessed through data cleaning, normalization, and feature selection techniques. To handle class imbalance and improve model performance, sampling methods such as Random Over Sampling and SMOTE (Synthetic Minority Over-sampling Technique) were applied.



Several machine learning algorithms were implemented and compared, including K-Means Clustering, Random Forest, Support Vector Machine (SVM), and Logistic Regression. These algorithms were trained to identify distinct user segments based on their transactional patterns. The experimental results demonstrated that clustering-based segmentation effectively grouped users into meaningful categories such as high-value customers, frequent spenders, moderate users, and low-activity users.

### Conclusion

This study presented a machine learning-based approach for classifying credit card user segments through transactional behaviour analysis using advanced ML algorithms and

sampling techniques. The proposed system focused on analyzing customer transaction patterns such as spending frequency, payment behaviour, credit utilization, and cash advance usage to identify meaningful user segments. Various machine learning algorithms were applied and evaluated to determine their effectiveness in segmenting credit card users. Sampling methods were incorporated to address data imbalance and improve model performance. The experimental results demonstrated that the integration of advanced machine learning algorithms with appropriate sampling techniques significantly improves the accuracy and reliability of user segmentation.

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