

# **PREDICTIVE MODEL IN DETECTION OF CREDIT CARD DEFAULTERS BY PURNIMA SINGH**

## **ABSTRACT**

This research is focusing on application of machine learning (ML) techniques to predict customer eligibility for a credit card to mitigate possible future credit risk which may affect the bank's financial stability and credit performance. Credit card is a credit facility given for a customer by banks and finance companies around the globe. The credit facility has a credit risk for the banks and financial companies. The repayments are least assured and it often ends up as a non-performing credit facility (NPL). To mitigate credit risk banks are assessing applicant's creditworthiness and checking the eligibility before granting a credit facility. The decision is mostly based on traditional credit scoring models and credit worthiness will not always be accurate. This project aims to help banking and financial institutions to identify and interact with creditworthy customers by using predictive models

Commercial banks receive a lot of applications for credit cards. Many of them get rejected for many reasons, like high loan balances, low-income levels, or too many inquiries on an individual's credit report, for example. Manually analysing these applications is mundane, error-prone, and time-consuming (and time is money!).

This task can be automated with the power of machine learning and pretty much every commercial bank does so nowadays. In this notebook, we will build an automatic credit card approval predictor using machine learning techniques, just like the real banks do.

## **INTRODUCTION**

Non-performing assets (NPA). One of them is whether or not to give credit to the customer.

Leverage major bank decisions to directly reduce potential NPAs. credit card as balance

A facility instrument required by a bank to effectively manage the facility's credit This project focuses on application of machine learning (ML) techniques to predict customer eligibility for a credit card.

The banking sector is undergoing a fundamental shift in how it engages and earns the trust of its customers. Industry dynamics are driven by innovative business models in market lending, advances in blockchain technology, and emerging trends in investment management. Banks, especially public sector banks in emerging markets, are under tremendous pressure to deliver superior customer service to reduce margins and win customer trust. Advances in technology have led to the digitization of branches. Allied Market Research reports provide insight into key industry dynamics, prominent trends, portfolio mixes of top banks, and factors shaping the competitive landscape scenario.

Credit can be defined as risk

The bank's potential loss if the borrower fails to meet its obligations (interest, principal). Continuous monitoring of customer payments can reduce the likelihood of accumulation risk.

Granting a credit card to a customer requires some manual steps. judgement

Confirmation of the applicant's creditworthiness and eligibility is a decisive factor, Banks assume that credit ratings are not always correct. Machine application

Learn techniques to eliminate manual work, time-consuming processes, and more

Critical data-driven decisions before a customer are given a credit card.

Previously, banks had to ask applicants to provide a credit card.

Background and history to understand the applicant's creditworthiness .We

match application data with reference documents, but this process does not.

Always right, customers and banks struggled to authorize credit cards.

Mitigating credit risk and automating credit scoring by correctly predicting customer eligibility. Customer demographics and historical transaction data. Moreover, ML helps with the process of making smarter, datadriven decisions for our customers.

## COMPONENT OF A CREDIT CARD



The illustrated components of a credit card and details of components were listed below.

- **Issuer Logo:** In front of the credit card, credit card network logo (e.g. visa, master) and issuing bank logo displayed.
- **EMV Chip:** The chip stores card data in an encrypted way to prevent stealing of credit card number easily.
- **Magnetic Strip:** The magnetic strips are readable through some specific machines used for monetary transactions. Also, it contains account data.
- **Card Holder Name and Card Number:** Card holder name & Credit Card number appeared in front side of the card.
- **Credit Card Expiration Date:** Card has an expiration date. The date shows the month and the year and helps merchants to identify the validity of the card.
- **Signature Box:** Signature box is the place cardholders are supposed to place their signature.

- **CVV Code:** In back side of the card there is CVV number. It is three-digit combination and used to protect customers' financial transaction from fraud and theft.
- **Hologram:** In the backside of card unique three-dimensional hologram display of credit card network. (E.g., Visa uses a dove hologram, MasterCard – a world map).

## **Market evolution for credit cards**

The last decade in the credit card industry has laid the foundation for constant evolution and growth of the same. With its steady focus on newer customer segments with differentiated product offerings, loyalty and experiences supported by enabling technology platforms and solutions, the industry is expected to grow exponentially in the upcoming years.

## **Focus on new customer segments**

Traditionally, credit card products are focused on specific segments and groups such as people with high income, salaried professionals, population in tier I cities and customers with a good credit score.

Thus, there is an emerging need to penetrate newer segments that would widen the customer base for credit cards and encourage their adoption among masses.

### **Credit Line**

A line of credit (LOC) is a stipulated amount of money that a card issuer has agreed to lend for a customer at the beginning of credit card account opening. Until the limit is reached, the

borrower can draw money from the credit card and as money is repaid, it can be borrowed again in the case of an open line of credit. Credit line can be increase after evaluating customer's repayment capacity later.

## **Types of Credit Cards**

Most popular credit card networks/brands are Visa, MasterCard and American Express. These cards were issued by banks and financial institutions. Different types of credit cards categories are in a particular brand as well such as for low net worth, medium net worth and high net worth customers. To attract more customers, different incentives are offering such as airline miles, hotel room booking, restaurant dine-in, super market grocery buying, gift certificates to major retailers and cash back on purchases. Furthermore, in some banks have established rewards system for credit card usage. At the end of year these rewards points can be redeemed. Branded versions of credit cards are issued to generate customer loyalty with store's name/ organization name emblazoned on the face of the cards. These credit cards called co-branded credit cards.

The main types of credit cards:

**Standard credit cards** are the most traditional type of credit card; they allow you to spend up to a pre-set credit limit, with no interest charged if you pay off the full balance by the due date every month.

**Rewards credit cards** operate similarly, but offer rewards such as travel points or cash back (usually in the form of a statement credit).

**Balance transfer credit cards** have low introductory interest rates to make it more attractive to transfer balances from other credit cards.

**Charge cards** may allow you to spend without limit, but you generally have to pay the balance in full each month.

**Student credit cards** are for college students seeking their first card.

**Business credit cards** can be used by business owners and employees, and may offer business-focused rewards.

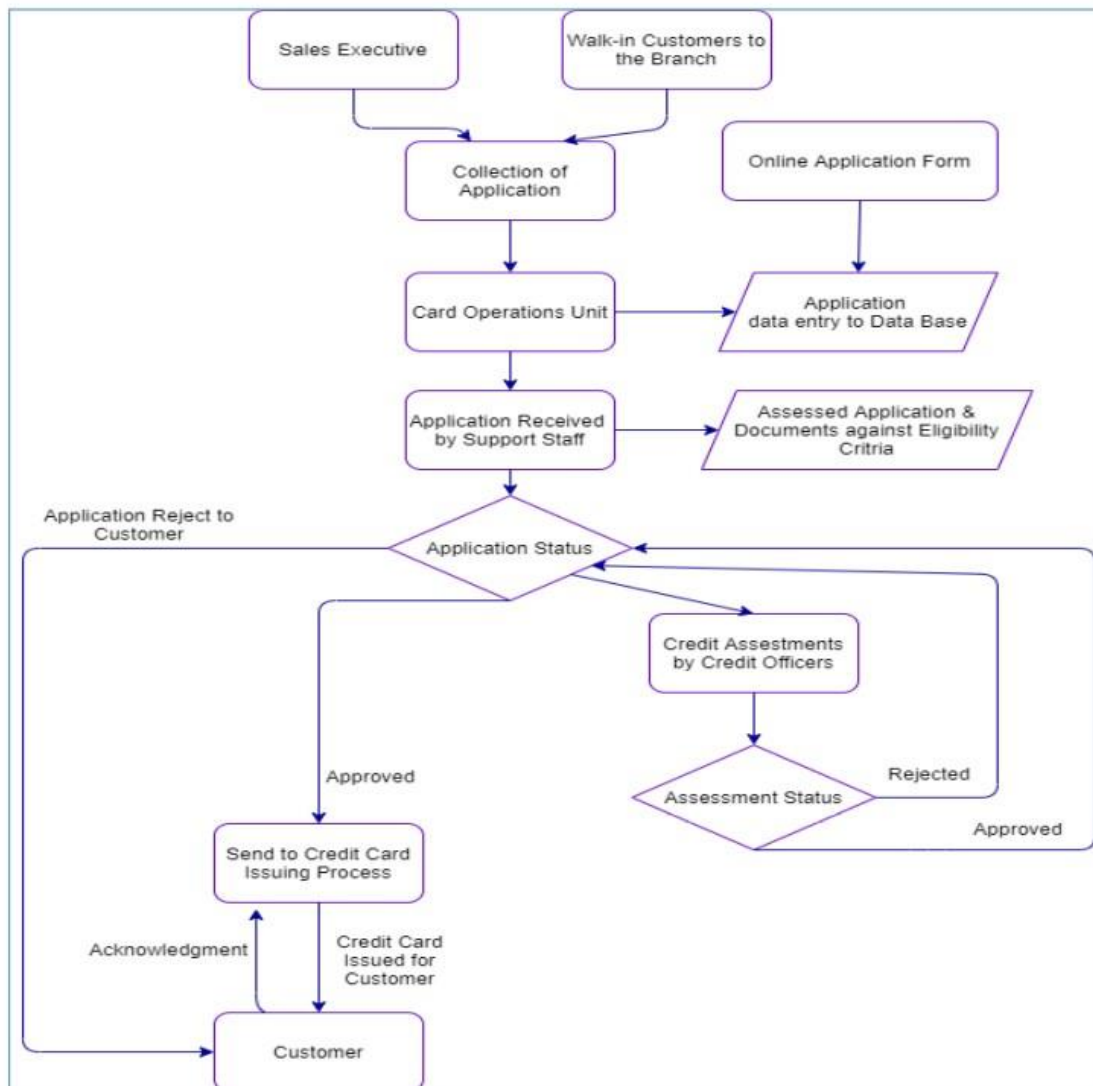
**Secured credit cards** require a cash security deposit that reduces risk for the credit card company.

**Limited-purpose credit cards** include store cards and gas cards that can only be used at specific retail locations.

**Prepaid cards** are not true credit cards; you have to load them with cash before you can use them for purchases.

### **Credit Card Issuing Process**

A relationship must be established before a credit card can be offered to a customer, customers and banks. Applying for a credit card for the first time takes time. Filling, completing an application form is compulsory and most banks these days allow online application by filling it out Application Form. Choosing the right card can be done after self-study or consultation sales department executives.



**Fig: - The credit card issuing process**

The sales department will send you a credit card application form with the required documents attached. Leads to branches or current customers. All applications are delivered to your credit card operating unit. Application data entered into the card application database. some bank offers Online application option. This application data is entered directly on the card. Application database by the applicant through the bank's designated online portal then the application review team evaluates and reviews applications, documents and eligibility criteria in accordance with internal policies and procedures. Eligible applications will not be rejected client. Eligible applications are sent to credit bureau and loan officer applications, accepted or rejected by the definition of LOC. Approved applications are added to the credit card issuance process and finally, the applicant receives a credit card and sends a confirmation letter to the bank.

## PROBLEM STATEMENT

This is a classification problem that requires predicting whether a credit card issue will be approved. In particular, this is a binary classification problem where one of the two classes given her must be predicted. H. Approved (Y) or not approved (N). Another way to frame the problem is to predict whether a loan is likely to default. If the loan is likely to default, it will not be approved and vice versa. The dependent or target variable

is Approval Status and the rest are independent variables or characteristics. I need to develop a model that uses the features to predict the target variable.

### **NEED ASSESSMENT OF ML IN THE CREDIT CARD BUSINESS: -**

Machine learning has become increasingly important in the credit card industry, as it can help identify patterns and predict creditworthiness with greater accuracy than traditional methods. Here is a brief assessment of the impact of machine learning in the credit card business:

**Fraud Detection:** One of the most significant applications of machine learning in credit cards is detecting fraud. Machine learning algorithms can identify patterns of fraudulent transactions and flag them for further investigation, helping to prevent financial losses.

**Credit Scoring:** Machine learning can also help credit card companies in making more accurate credit decisions. By analysing large volumes of data, machine learning algorithms can identify patterns and predict the likelihood of a customer defaulting on their credit card payments. This allows credit card companies to make more informed decisions about who to lend to and at what interest rate.

**Customer Segmentation:** Machine learning can also help credit card companies to segment customers based on their spending habits and behaviours. This helps companies to personalize their marketing efforts, offer targeted promotions and rewards, and tailor their product offerings to meet the specific needs of different customer segments.

**Personalized Offers:** By analysing customer data, machine learning algorithms can also help credit card companies to offer personalized recommendations and offers to customers. This helps to improve customer satisfaction and loyalty, and increase revenue for the credit card company.

**Risk Management:** Machine learning can help credit card companies to manage risk more effectively by identifying trends and patterns in credit card usage. This allows companies to proactively identify and manage potential risks, such as high-risk transactions or customers.

Overall, machine learning has the potential to transform the credit card industry by enabling companies to make more informed decisions, reduce fraud and risk, and offer personalized services to customers. However, it is important to note that machine learning is not a magic solution and must be used in combination with other methods and strategies to achieve the best results.

### **EXTERNAL SEARCHES: -**

<https://cloud.google.com/blog/products/data-analytics/how-to-build-a-fraud-detection-solution>

<https://github.com/ashishktripathi/Credit-Card->

<Approval/blob/master/CreditCardApproval.ipynb>

<https://archive.ics.uci.edu/ml/index.php>

<https://www.hindawi.com/journals/ddns/2021/5080472/>

Github.com

Kaggle.com

Stackoverflow.com                      sci-

hub.hkvisa.net/ Researchnet.com

Googlescholar.com

UCI repository

## **TARGET SPECIFICATIONS –**

The target specifications of a credit card approval prediction model may vary depending on the specific requirements of the application, but here are some general specifications that could be considered:

**Accuracy:** The model should be accurate in predicting whether a credit card application will be approved or rejected. The accuracy level should be high enough to minimize false positives and false negatives.

**Speed:** The model should be able to make predictions quickly, especially if it is being used in a real-time or near real-time application.

**Robustness:** The model should be robust enough to handle missing data, outliers, and other issues that may arise in real-world data.

**Explainability:** The model should be explainable so that it is possible to understand why a certain prediction was made. This is important both for understanding the factors that affect credit card approval decisions and for building trust with users.

**Scalability:** The model should be scalable to handle large volumes of data and to work in different environments, such as cloud computing or edge devices.

**Privacy:** The model should protect the privacy of the applicants' sensitive information and comply with relevant data protection regulations.

**Integration:** The model should be easy to integrate with other systems, such as credit scoring or customer relationship management (CRM) systems.

**Cost-effectiveness:** The model should be cost-effective to develop, deploy, and maintain, while still meeting the required specifications.

## **BENCHMARKING: -**



## Rule-based vs ML-based Fraud Detection Systems

Rule-based fraud detection	ML-based fraud detection
Catching obvious fraudulent scenarios	Finding hidden and implicit correlations in data
Requires much manual work to enumerate all possible detection rules	Automatic detection of possible fraud scenarios
Multiple verification steps that harm user experience	The reduced number of verification measures
Long-term processing	Real-time processing

### APPLICABLE GOVERNMENT AND ENVIRONMENTAL REGULATIONS: -

In the context of credit card approval prediction models, there are several applicable regulations that financial institutions, banks, and credit card companies must comply with. These regulations can be broadly classified into two categories: government regulations and environmental regulations.

#### Government Regulations:

**Fair Credit Reporting Act (FCRA):** The FCRA regulates the use of consumer credit information by credit reporting agencies, including the use of credit scores in making credit decisions. Financial institutions and credit card companies must comply with the FCRA to ensure that they are using consumer credit information in a fair and accurate manner.

**Equal Credit Opportunity Act (ECOA):** The ECOA prohibits discrimination in credit decisions based on factors such as race, gender, and marital status. Financial institutions and credit card companies must comply with the ECOA to ensure that they are making credit decisions based on objective factors, such as credit history and income.

**Consumer Financial Protection Bureau (CFPB):** The CFPB is a federal agency that regulates consumer financial products and services, including credit cards. Financial institutions and credit card companies must comply with CFPB regulations to ensure that they are offering credit products that are fair, transparent, and easy to understand.

#### Environmental Regulations:

**Privacy Regulations:** Financial institutions and credit card companies must comply with privacy regulations to ensure that they are protecting consumer information from unauthorized access or disclosure. These regulations include the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA).

**Security Regulations:** Financial institutions and credit card companies must comply with security regulations to ensure that they are protecting consumer information from cyber threats and other security breaches. These

regulations include the Payment Card Industry Data Security Standard (PCI DSS) and the New York State Department of Financial Services (NYDFS) Cybersecurity Regulation.

Overall, financial institutions, banks, and credit card companies must comply with a variety of government and environmental regulations when developing and deploying credit card approval prediction models. By complying with these regulations, they can ensure that their credit products are fair, transparent, and in compliance with applicable laws and regulations.

### **Applicable budget constraints for the credit card approval prediction model**

In building a credit card approval prediction model, the applicable budget constraints could include:

**Data collection costs:** Collecting the relevant data on credit history, income, employment status, and other variables that are used to assess creditworthiness may require paying fees to credit bureaus or other data providers.

**Computing infrastructure costs:** Running and maintaining the predictive model will require computing resources, which may involve costs such as server rental fees or cloud computing charges.

**Personnel costs:** Building and maintaining a credit card approval prediction model may require the expertise of data scientists, software developers, and other personnel, whose salaries and benefits will need to be factored into the budget.

**Training and education costs:** If the organization lacks the necessary expertise to build a predictive model inhouse, training or hiring outside consultants may be necessary, which may involve additional costs.

**Model monitoring and maintenance costs:** Once the model is deployed, ongoing monitoring and maintenance will be required to ensure that it continues to provide accurate predictions. This may involve additional personnel costs or computing infrastructure costs.

Overall, the budget for a credit card approval prediction model will depend on a variety of factors, including the complexity of the model, the amount and quality of data available, and the organization's internal resources and expertise.

### **Applicable expertise constraints for the credit card approval prediction model**

In building a credit card approval prediction model, the applicable expertise constraints could include:

**Data science expertise:** Developing a credit card approval prediction model requires a strong understanding of statistical and machine learning techniques, as well as experience in data pre-processing, feature engineering, and model selection and evaluation.

**Domain expertise:** Understanding the credit industry, the factors that determine creditworthiness, and the regulatory and legal requirements surrounding credit approval is essential for building a predictive model that is both accurate and compliant.

**Software engineering expertise:** Building and deploying a credit card approval prediction model will require software development skills, including proficiency in programming languages such as Python or R, experience with version control systems, and knowledge of software design patterns and best practices.

**Data governance expertise:** Ensuring that the data used to train and evaluate the model is accurate, complete, and appropriately secured requires expertise in data governance and privacy regulations.

**Model monitoring and maintenance expertise:** Once the model is deployed, ongoing monitoring and maintenance will be required to ensure that it continues to provide accurate predictions. This may involve expertise in anomaly detection, performance optimization, and model updating.

Overall, building a credit card approval prediction model requires a diverse range of expertise, spanning data science, domain knowledge, software engineering, and data governance. The availability of these skills will be a significant constraint on the organization's ability to develop a successful predictive model.

## **BUSINESS MODELS: -**

The Credit Card Prediction Model can be monetized in the following ways: -

**Licensing:** Credit card prediction models can be licensed to credit card companies, financial institutions, or other companies that use credit data to assess customer risk. The license fee can be based on the usage of the model or a fixed fee.

**Consulting services:** Consulting services can be offered to help financial institutions and credit card companies improve their credit risk assessment strategies using the prediction model. Consulting services can include analysis of credit data, customization of the model, and implementation support.

**API access:** An API (Application Programming Interface) can be created for the credit card prediction model, allowing other companies to integrate the model into their own software. This can be offered as a paid service with a subscription fee or usage-based pricing.

**Data analysis:** Credit card prediction models generate a large amount of data that can be analysed to gain insights into credit trends and behaviors. This data can be used to create reports or dashboards that can be sold to credit card companies or other businesses interested in the credit industry.

**Training:** Training services can be offered to financial institutions and credit card companies to help them understand the credit prediction model and how to use it to its full potential. Training services can be offered as a one-time fee or as an ongoing subscription service.

It's important to note that any monetization strategy for a credit card prediction model must comply with all applicable regulations and data privacy laws. Additionally, the model should be transparent and explainable to ensure that users can understand how the model works and how its predictions are generated.

## **Concept overview: -**

Credit card approval prediction models are mathematical algorithms that predict the likelihood of a credit card applicant being approved or rejected based on a set of features or variables. The model uses historical data to identify patterns and relationships that are indicative of a creditworthy or high-risk applicant.

Credit card approval prediction models typically use a combination of traditional statistical techniques and machine learning algorithms to make predictions. These models analyse a range of variables, such as an applicant's credit score, income, employment status, payment history, and other factors that may influence the credit decision.

The credit card approval prediction model typically involves the following steps:

**Data collection:** Historical data on credit card applicants is collected and stored in a data repository.

**Data pre-processing:** The data is cleaned, normalized, and transformed to ensure that it is in a suitable format for analysis.

**Feature engineering:** Relevant features are selected, and new features are created to improve the model's predictive power.

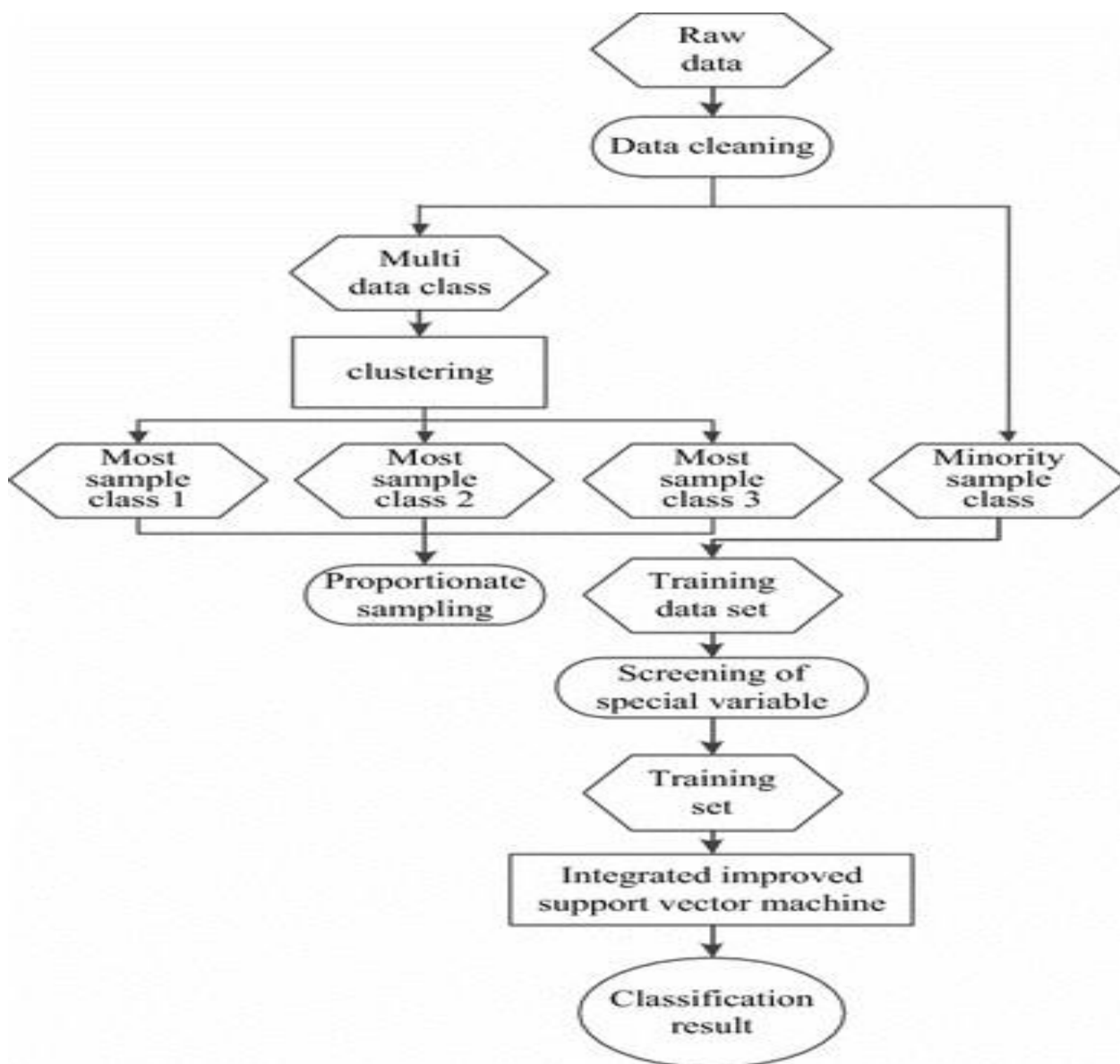
**Model training:** The data is split into training and validation sets, and a machine learning algorithm is trained on the training set to create a predictive model.

Model evaluation: The model's performance is evaluated on the validation set to assess its accuracy, precision, recall, and other performance metrics.

Model deployment: The model is deployed in a production environment, where it can be used to make real-time credit decisions.

Credit card approval prediction models can help financial institutions to automate and streamline the credit approval process, reduce risk, and improve the customer experience. By accurately predicting the likelihood of approval or rejection, these models can help financial institutions to make more informed credit decisions, reduce losses due to defaults and fraud, and offer credit products to a broader range of customers.

#### SCHEMATIC DIAGRAM OF THE MODEL: -



## **DATA SOURCES: -**

The data set has been taken from UCI Machine Learning Repository. The structure of this notebook is as follows:

We have loaded the dataset and on displaying the data set we can see that the dataset has a mixture of numeric and non-numeric characteristics, it contains various ranges of values, and contains many missing entries.

Therefore, the dataset needs to be pre-processed so that the selected machine learning model can make good predictions.

After the pre-processing is complete, we have done exploratory data analysis to build intuitive machine learning model that can predict whether an individual's credit card application will be approved.

## **Data Description: -**

This file concerns credit card applications. All attribute names and values have been changed to meaningless symbols to protect confidentiality of the data. This dataset is interesting because there is a good mix of attributes -- continuous, nominal with small numbers of values, and nominal with larger numbers of values. There are also a few missing values.

Number of Instances: 690

Number of Attributes: 15 + class attribute

Attribute Information:

A1: b, a.

A2: continuous.

A3: continuous.

A4: u, y, l, t.

A5: g, p, gg.

A6: c, d, cc, i, j, k, m, r, q, w, x, e, aa, ff.

A7: v, h, bb, j, n, z, dd, ff, o.

A8: continuous.

A9: t, f.

A10:t, f.

A11: continuous.

A12:t, f.

A13: g, p, s.

A14: continuous.

A15: continuous.

A16: +, - (class attribute)

#### Missing Attribute Values:

37 cases (5%) have one or more missing values. The missing values from particular attributes are:

A1: 12

A2: 12

A4: 6

A5: 6

A6: 9

A7: 9

A14: 13

#### 9. Class Distribution

+: 307 (44.5%)

-: 383 (55.5%)

#### **ALGORITHMS: -**

Machine learning algorithm that can best solve the problem of predicting credit card approval. Some of the popular algorithms for this type of problem include logistic regression, decision trees, random forest, support vector machines, and neural networks.

#### **Team Required: -**

Building a predictive model for the credit card approval process requires a diverse team of professionals with different skills and expertise. Here are some of the roles that may be required:

- Data Analyst
- Data Scientist
- Business Analyst
- Domain Expert
- Project Manager
- Software Engineer

- Quality Assurance Engineer
- User Experience Designer

#### **FINAL EQUATION: -**

The credit card approval prediction model's profitability is determined by the number of approved applications and the cost of developing the model.

To calculate the profit, the credit card company can use the equation: profit = revenue - development cost.

The revenue generated in a month is Rs.500 per approved application,

represented by the equation  $r = 500 * y(t)$ , where  $y(t)$  is the number of approved applications in that month.

The development cost is the sum of the salaries of the data analyst, data scientist, and software engineer, represented by  $c = da + ds + se$ .

By using this equation, the credit card company can estimate their profits and use the information to make informed decisions regarding pricing and resource allocation.

#### **CONCLUSION: -**

In conclusion, a credit card approval prediction model is a valuable tool that can help credit card companies make faster and more accurate decisions on credit card applications. The model uses machine learning algorithms to analyse applicant data and predict the likelihood of credit card approval. By automating the credit card approval process, the model can reduce the time and cost associated with manual underwriting and improve the overall efficiency of the credit card application process.

However, it is important to note that the credit card approval prediction model is only as good as the data and features used to train it. Therefore, it is critical to collect and pre-process high-quality data and select the most relevant and informative features to ensure the accuracy and reliability of the model. Additionally, the model should be regularly updated and retrained to account for changes in the credit card industry and to maintain its accuracy over time.

Finally, it is important to ensure that the credit card approval prediction model is used responsibly and ethically. Credit card companies must ensure that the model does not discriminate against certain groups of applicants and that the model's decisions are transparent and explainable. By taking these factors into account, credit card companies can leverage the benefits of a credit card approval prediction model while ensuring fairness and transparency in their decision-making processes.