**Phase-2 Submission**

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**Institution:** Dhanalakshmi College of Engineering

**Department:** Computer Science and Engineering

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**Github Repository Link:  [Github link](https://github.com/rakshid2201/NM_rakshiD.git)**

### ***Problem Statement***

***“Predicting customer churn using machine learning to uncover hidden patterns”***

### ***Real-world Problem:***

### *The project addresses a* ***customer churn prediction*** *problem in the* ***retail/subscription domain****. Businesses relying on subscription models (e.g., telecom, streaming services, SaaS platforms) suffer losses when customers cancel or downgrade their plans. Churn directly affects revenue, growth, and brand loyalty.*

### ***Problem Type:***

### ***Classification Problem****: The goal is to classify customers based on their* ***churn risk score****, which ranges from* ***1 (low risk)*** *to* ***5 (high risk)****.*

### ***Why It Matters:***

### ***Business Impact****: Knowing which customers are likely to churn enables proactive retention strategies, personalized campaigns, and reduced customer acquisition costs.*

### ***Customer Experience****: Helps in identifying dissatisfaction triggers early and offering tailored solutions.*

### ***Relevance****: Applicable across any domain involving recurring users or subscription-based models.*

### ***Project Objectives***

### ***Primary Goals:***

### *Accurately* ***predict the churn risk score*** *using machine learning models.*

### *Understand* ***key factors influencing churn****, like login frequency, complaints, offer preference, and region.*

### ***Build interpretable models*** *to aid decision-makers in strategizing retention.*

### ***Technical Objectives:***

### *Perform* ***data preprocessing****, handle missing data, outliers, and irrelevant columns.*

### *Conduct* ***Exploratory Data Analysis (EDA)*** *to derive insights.*

### *Engineer new features if necessary.*

### *Implement and compare at least* ***two classification algorithms****.*

### *Evaluate using appropriate metrics:* ***accuracy, precision, recall, and F1-score****.*

### ***Updated Objective Post-EDA:***

### *Drop features with high missing or noisy data (e.g., avg\_frequency\_login\_days).*

### *Focus on* ***simplifying the model while improving accuracy****.*

### ***3. Flowchart of the Project Workflow***

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### **4. Data Description**

### ***Source:*** [*Dataset link*](https://www.kaggle.com/datasets/harshitstark/bank-churn-train)

### ***Type: Structured Dataset*** *in tabular format.*

### ***Shape: 36,992 records****,* ***25 features*** *(columns).*

### ***Static or Dynamic: Static*** *dataset.*

### ***Target Variable:*** *churn\_risk\_score (integer from 1 to 5).*

### ***Feature Types:***

### ***Numerical Features****: age, days\_since\_last\_login, avg\_transaction\_value, points\_in\_wallet, etc.*

### ***Categorical Features****: gender, region\_category, membership\_category, feedback, etc.*

### ***Datetime Fields****: joining\_date, last\_visit\_time.*

### **5. Data Preprocessing**

***1. Missing Values:*** *region\_category (5,428 nulls), points\_in\_wallet (3,443 nulls) filled using* ***median imputation****.*

***2. Data Type Conversion:*** *Converted joining\_date and last\_visit\_time to* ***datetime64****.*

***3. Error Handling:*** *Replaced incorrect churn\_risk\_score values like -1 using* ***custom functions (def, lambda)*** *based on pattern analysis.*

***4. Dropped Irrelevant/Redundant Features:*** *customer\_id, name, security\_no, referral\_id, avg\_frequency\_login\_days — due to low relevance or data quality issues.*

***5. Encoding Categorical Data:*** *Though not shown explicitly, encoding (label or one-hot) was likely applied during modeling phase.*

***6. Null Thresholding:*** *Rows with* ***<5% missing values*** *were dropped to preserve data quality.*

### **6. Exploratory Data Analysis (EDA)**

***Univariate Analysis:***

* ***Gender****: Balanced male/female distribution.*
* ***Region Category****: Most customers are from towns > cities > villages.*
* ***Membership****: Basic and non-membership dominate over premium memberships.*
* ***Referral****: More customers joined without referrals.*
* ***Offer Type****: Clear distribution of preferences among offer categories.*

***Numerical Columns:*** *Distribution of age, avg\_time\_spent, transaction value, and login behavior studied via histograms and box plots.*

***Bivariate Analysis:***

* *Heatmap used to detect correlation between numerical variables.*
* *Example: Users with more complaints or less time spent showed higher churn.*

***Insights Summary:*** *Users with limited engagement, low wallet points, and past complaints are likely to have higher churn scores.*

### **7. Feature Engineering**

***Steps Taken:***

* *Removed noisy or irrelevant features.*
* *Created cleaner variables from date fields (not detailed).*
* *Prepared a* ***base model*** *with refined features post-EDA and preprocessing.*

### **8. Model Building**

### ***Algorithms Used:***

### *At least one* ***base classification model*** *implemented.*

### *(Specific algorithms like Logistic Regression, Decision Trees, Random Forest are typical but not named here).*

### ***Data Split:***

### *Presumably a* ***train-test split*** *was used.*

### ***Evaluation Metrics:***

### ***Accuracy*** *reported.*

### *Other metrics like precision, recall, and F1-score expected in final evaluation.*

### **9. Visualization of Results & Model Insights**

***Visual Tools:***

* *Bar plots for counts, heatmaps for correlation.*
* *Visualized distributions across customer segments.*

***Model Interpretation:***

* *Confusion matrix used to measure classification performance.*
* *Key variables (wallet points, complaints, membership) influence churn risk.*

### **10. Tools and Technologies Used**

* ***Language****: Python*
* ***Libraries****: pandas, numpy, matplotlib, seaborn, scikit-learn*
* ***IDE****: Likely Jupyter Notebook or Google Colab (not explicitly stated)*
* ***Visualization****: matplotlib, seaborn*

### **11. Team Members and Contributions**

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| *Team Members:* | *Roles:* | *Contribution:* |
| *Vidhya.S* | *Team Leader* | *Model planning , Final report, Documentation* |
| *Santhanayaki.M* | *Member* | *Data cleaning, EDA, Preporcessing* |
| *Saghana.K.S* | *Member* | *Feature Engineering , Code integration,Documentation* |
| *Rakshi.D* | *Member* | *Model building, Evaluation ,Data Transformation* |