

# Bank Consumer Complaint Classification

A Natural Language Processing (NLP) Capstone Project

**Authors:** Phase5\_Group6: *Mary Musyoka, Julian Kilyungi, Tabitha Kariuki, John Kul, Norah Oluoch and Joseph Ngige.*

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# Executive Summary

**Project Goal:** Use NLP to simplify and accelerate customer complaint classification, reducing submission time and complexity with an intuitive interface.

**Model Selection:** BERT chosen after evaluating models like Multinomial Naive Bayes, SVM, Logistic Regression, Random Forest, and ExtraTrees. BERT achieved a *Macro F1-score* of 0.85, *Weighted F1-score* of 0.89, and 89% accuracy, providing balanced and reliable classifications.

**Deployment:** Deployed on Hugging Face with a Streamlit interface, allowing customers to input complaints. Classified results are sent via Africastalking's SMS API to both customers and relevant support teams for quick response.

**Future Improvements:** Implement feedback loops for retraining, optimize complaint-specific categories, and expand notification channels to enhance accuracy and adaptability.

# Outline

- Project Overview
- Business Understanding
- Data Understanding & Preparation
- Modeling & Evaluation
- Deployment & Application
- Conclusion & Recommendations

# Project Overview

**Goal:** Simplify and streamline customer complaint classification using NLP to minimize survey questions and enhance the submission process.

**Objectives:**

1. Train an NLP model for accurate complaint categorization.
2. Reduce complaint logging time and improve user experience.
3. Enhance bank responsiveness with faster, precise complaint handling.

**Approach:** *Data preparation:* handling missing values, duplicates, and applying TF-IDF and scaling; *Model training:* Multinomial Naive Bayes, SVM, Logistic Regression, Random Forest, ExtraTrees, and BERT; BERT with **Macro F1-score: 0.85, Weighted F1-score: 0.89, Accuracy: 89%** selected.

**Deployment and Application:** Deployed on Hugging Face with a Streamlit interface; Complaints are classified in real-time and routed via SMS to the appropriate support team and the customer.

# Business Understanding

- **Problem Statement:**  
Financial institution customers face frustration due to complex complaint submission processes, including redundant chatbot questions and lengthy navigation. A streamlined system is needed to reduce steps and improve efficiency.
- **Root Causes:**
  - Complex navigation and cumbersome menus.
  - Inefficient chatbots with redundant questions.
  - Lack of personalized pathways for different complaint types.
  - Limited use of data to streamline the process, leading to repetitive requests.
- **Key Stakeholders:**
  - **Customers:** Need a quick, simple way to submit complaints.
  - **Customer Support Teams:** Require efficient categorization tools to resolve issues promptly.

# Data Understanding & Preparation

**Dataset Source:** Consumer Complaints Dataset from the US Consumer Financial Protection Bureau (CFPB), sourced from [Kaggle](#).

**Complaint Categories:**

1. Credit Reporting
2. Debt Collection
3. Mortgages and Loans
4. Credit Cards
5. Retail Banking

**Key Details:**

- ~162,400 records with varying narrative lengths.
- Imbalanced data: 56% of complaints focus on credit reporting, requiring tailored strategies for balanced classification.

# Data Understanding & Preparation

## Exploration Highlights:

- Removed unnecessary columns and handled missing values.
- Retained 37,735 duplicate entries due to their positive impact on model performance.
- Addressed class imbalance (notably in the credit reporting category) through stratified splits and SMOTE.
- Text length analysis revealed a right-skewed distribution, with most narratives under 1,000 characters.

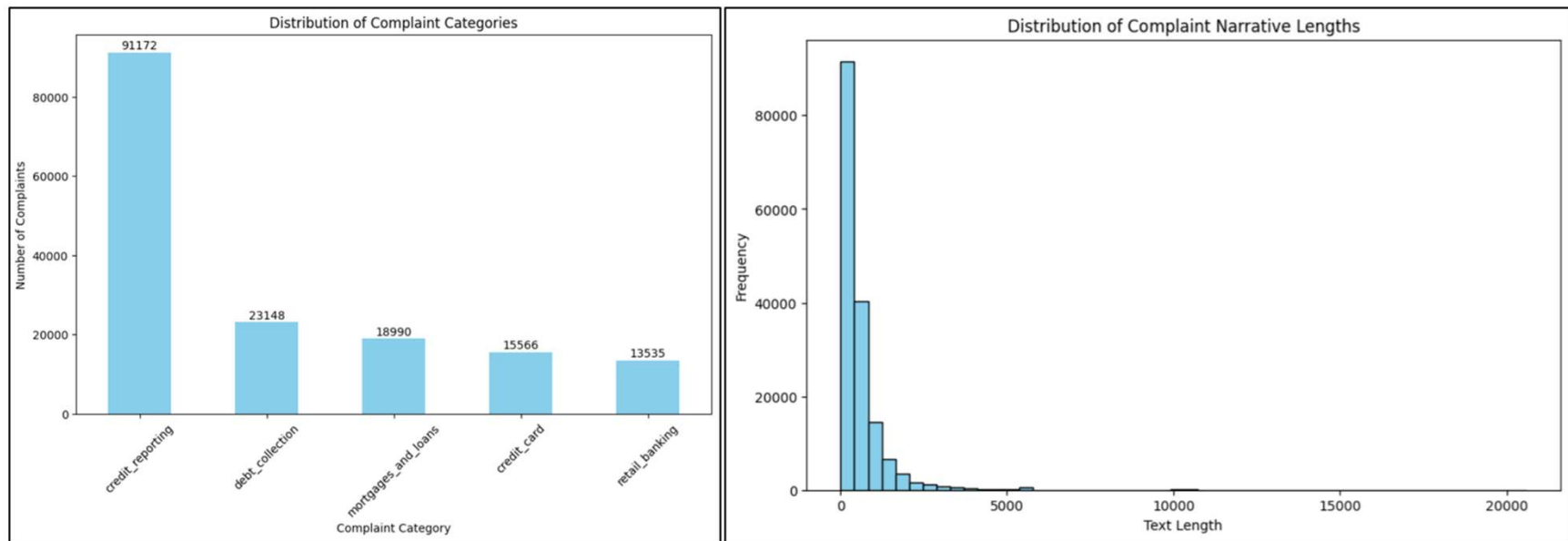
## Preprocessing Steps:

- Standardized text (lowercasing, removing special characters, handling whitespace).
- Tokenization, stop word removal, and lemmatization to clean and normalize text.

## Data Transformation:

- Applied TF-IDF for weighted feature representation.
- Used MinMax scaling for feature standardization.
- Created balanced and optimized train-test datasets for modeling.

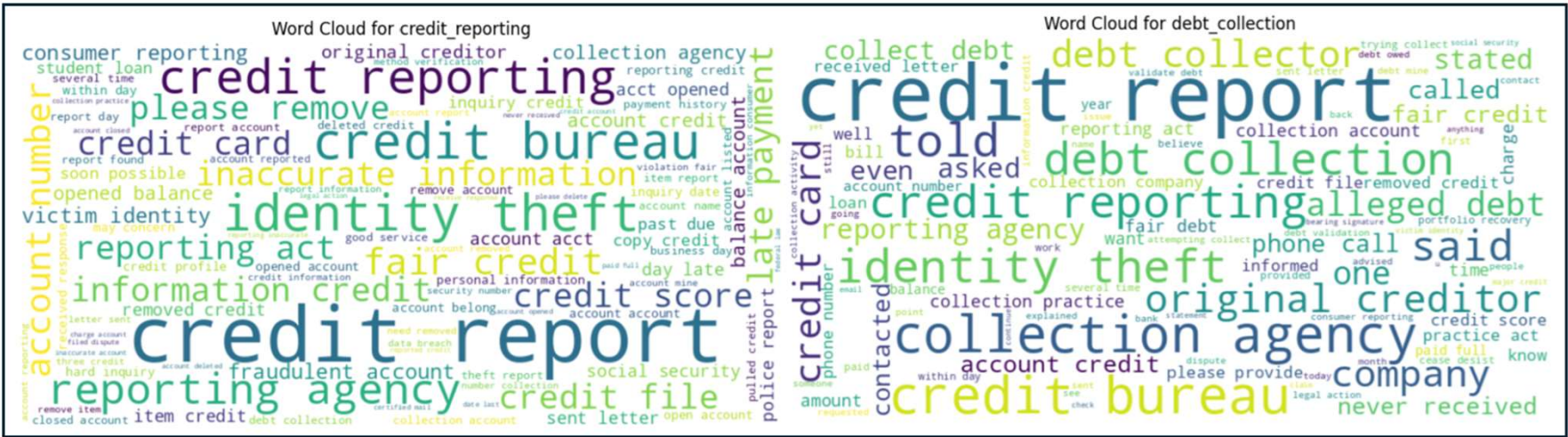
# Data Understanding & Preparation



**Left:** The distribution of Complaint Categories shows a class imbalance, with the `credit_reporting` category significantly more represented than others. **Right:** The histogram indicates a right-skewed distribution, with most narratives having fewer than 1,000 characters.



# Data Understanding & Preparation



Word cloud highlighting specific terms associated with common issues for each product. Shows that customer complaints are centered around distinct themes based on the product type.

# Modeling & Evaluation

**Baseline Models Trained:** Multinomial Naïve Bayes, SVM, Logistic Regression, and Random Forest.

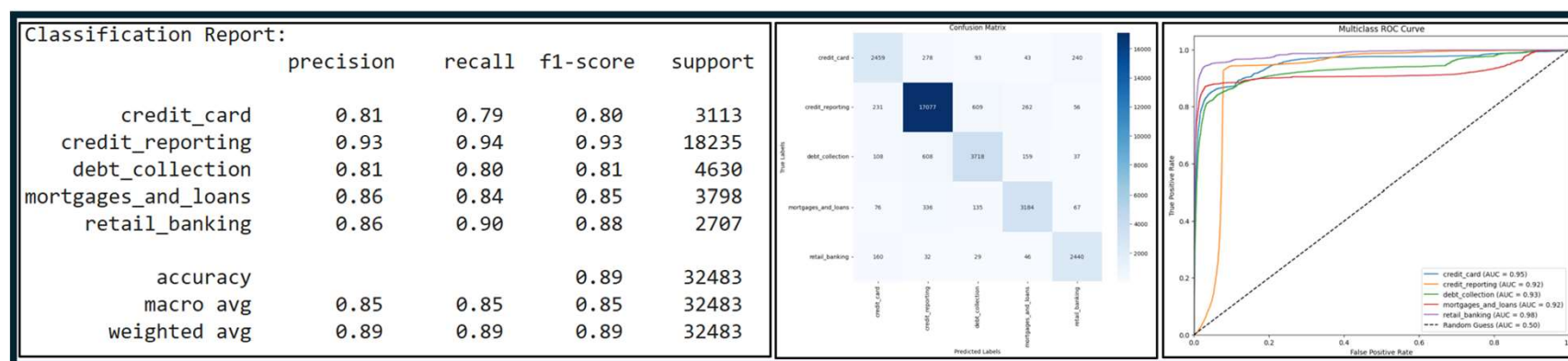
**Evaluation Metrics:** Focused on **Macro F1-score** (equal weighting across classes) and **Weighted F1-score** (accounts for class imbalance).

**Model Improvement:**

- Tuned Random Forest for better performance.
- Applied SMOTE to balance data and trained Random Forest and ExtraTrees models.
- Explored **BERT**, which excelled due to its deep language understanding, achieving balanced and robust classification.

**Final Selection:** **BERT** chosen for deployment for its strong performance and suitability for NLP tasks.

# Modeling & Evaluation



**Left:** The BERT classification report. **Middle:** The BERT confusion matrix reflects good differentiation across categories, with relatively few off-diagonal errors. **Right:** The AUC-ROC curve for the BERT model demonstrates high discriminative power across all complaint categories, with AUC values ranging from 0.92 to 0.98.

# Deployment & Application

## Approach:

- **User-Friendly Interface:** Built with Streamlit, allowing customers to submit complaints along with their phone and account details.
- **Model Integration:** BERT classifies complaints in real-time based on input data.
- **Automated Notifications:** Integrated with Africastalking's SMS API to notify both the support team and the customer of complaint details. SMS was chosen over email for faster delivery.
- **Deployment:** Deployed on Hugging Face for easy access via a [link](#).
- **Future Enhancements:** Implement a feedback loop to retrain the model and improve adaptability.

## Challenges:

- SMS notifications are limited to Airtel and Telkom due to restrictions on Safaricom.
- Email notifications were slower and replaced with SMS.

# Deployment & Application

## Complaint Classifier

Enter your complaint:

My mortgage application was declined without any valid reason.

Enter your phone number:

+254788 [REDACTED]

Enter your account number:

345698765

Classify and Send SMS

Complaint: My mortgage application was declined without any valid reason. Predicted Category: mortgages\_and\_loans Account Number: 345698765

*Snapshot of the system user interface that includes only three fields for complaint, phone number and account number.*

# Conclusion & Recommendations

**Model:** BERT chosen for its strong NLP capabilities, achieving a Macro F1-score of 0.85 and Weighted F1-score of 0.89, ensuring reliable and accurate complaint classification.

**Deployment:** Model integrated with Streamlit and deployed on Hugging Face, providing a seamless complaint submission experience with automated SMS notifications for quick resolution.

**Insights and Impact:** Streamlined complaint submission process, reduced customer friction, and improved response times by categorizing complaints and routing them to appropriate support teams efficiently.

## **Limitations and Future Work:**

- Accuracy varies across complaint types; further tuning and data augmentation are needed.
- SMS notifications are currently limited to Airtel and Telkom networks.
- Recommendations include implementing a feedback loop for retraining, expanding notification channels, and optimizing model performance for specific categories.

# Questions?

## DSF-PT7 Phase 5\_Group 6 Members Contact:

Mary Musyoka: [mary.musyoka@student.moringaschool.com](mailto:mary.musyoka@student.moringaschool.com)

Julian Kilyungi: [julian.kilyungi@student.moringaschool.com](mailto:julian.kilyungi@student.moringaschool.com)

Tabitha Kariuki: [tabitha.kariuki1@student.moringaschool.com](mailto:tabitha.kariuki1@student.moringaschool.com)

John Kul: [john.kul@student.moringaschool.com](mailto:john.kul@student.moringaschool.com)

Norah Oluoch: [norah.oluoch@student.moringaschool.com](mailto:norah.oluoch@student.moringaschool.com)

Joseph Ngige: [joseph.ngige@student.moringaschool.com](mailto:joseph.ngige@student.moringaschool.com)

# Thank you.