Spam Detection: A Comparative Analysis

Group Members

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1. Introduction

Spam emails disrupt communication by sending unsolicited and often malicious messages, threatening user security and productivity. Detecting spam is a critical NLP application that aims to safeguard individuals and organizations from fraud, malware, and information overload. The objective of this project is to evaluate and compare the performance of multiple models to determine which achieves the highest metrics and reliability in identifying spam. We highlight the evolving nature of spam, including image-based, obfuscated, and context-aware attacks, emphasising the real-world impact of effective detection.

2. Dataset Description

We utilize the Enron Spam Dataset, which contains 33,716 emails consisting of 17,171 spam and 16,545 ham messages. This includes subjects, message bodies, labels, and dates. The dataset is publicly available and well-balanced, enabling rigorous supervised learning and facilitating benchmarking against prior studies. All data usage complies with licensing and ethical standards.

3. Problem Statement and Task

Given the text content of an email, either its subject and/or body. The task is to classify it as "spam" or "ham" (non-spam). The primary challenge lies in detecting diverse spam tactics while minimizing false positives on legitimate emails. Following classification, a comparative analysis across different models will determine which approach is most suitable for this detection task.

4. Proposed Approach

We plan to use six different machine learning models: Naïve Bayes, Logistic Regression, BERT, SVM, Random Forest, and K-Nearest Neighbors.

5. Evaluation Metrics

Our primary evaluation metric will be the macro-average F1 score, which fairly balances precision and recall for both spam and ham classes. Additionally, we will report accuracy, precision, and recall as secondary metrics. Comparing the evaluation scores of the proposed models, we will provide a detailed comparative analysis report.