

Part B – Reflection Paper

What I Implemented

In this project, I built a spam detection system using **Logistic Regression**, **Random Forest**, and **Naive Bayes**. First, I changed the email text into numbers using **TF-IDF** so the models could read the words. Logistic Regression and Naive Bayes worked directly with the TF-IDF data, while Random Forest needed a dense version of the same features. After training the models on a dataset of spam and ham (not spam) messages, I tested them on new messages to measure accuracy, precision, recall, and F1-score.

Comparison of Models on Sample Messages

I tested three example messages:

1. *“Free entry in 2 a weekly competition!”*
2. *“I will meet you at the cafe tomorrow”*
3. *“Congratulations, you won a free ticket”*

All three models gave the same results: the first and third messages were **Spam**, and the second message was **Ham**. This shows that each model correctly identified common spam words like “free,” “win,” and “congratulations.”

Understanding Naive Bayes

Naive Bayes is a **simple probability model**. It calculates how likely a message is spam based on the words inside. It assumes each word is independent of the others, which is why it is called “naive.” It is popular for spam detection because it is **fast, easy to train, and works well with text**, even if the independence assumption is not always true.

Metrics and Findings

In my results, **Logistic Regression** had the best balance of accuracy, precision, recall, and F1-score. Random Forest was close but slightly lower. Naive Bayes was good but missed a few spam messages.

The **confusion matrix** shows mistakes: false positives (ham marked as spam) and false negatives (spam marked as ham). Logistic Regression had the fewest errors overall.

Conclusion

All three models can detect spam well. However, I recommend **Logistic Regression** because it gave the best overall scores and made the fewest mistakes. Random Forest is also strong, and Naive Bayes is a good, fast option for quick setups.