


Project Report

A PROJECT REPORT SUBMITTED IN TRAINING PROGRAM OF


Artificial Intelligence –Machine Learning 

Submitted by:

 **Name of the Student :** RITESH VERMA

 **Enrollment Number:** 23071003547

 **Batch:** 2023-26

 **Institute:** Dr. Virendra Swaroop Institute of Computer Studies , Kanpur, U.P.

CANDIDATE'S DECLARATION

I, Ritesh Verma hereby certify that the work presented in this report, titled Spam Email Detection Using Machine Learning, submitted in partial fulfillment of the requirements for the training program on Artificial Intelligence – Machine Learning, is an authentic record of my group work . I have also duly cited all references for any data, text(s), figure(s), table(s), or equation(s) that have been taken from other sources.

Date: 01-07-2025

Project Overview

1. Project Title:

Spam Email Detection Using Machine Learning

2. Group Members:

- Om Tripathi
- Ritesh Verma

3. Project Objective:

The objective of this project is to develop a machine learning-based system that accurately detects whether an email message is **spam** or **ham** (not spam). This helps reduce unnecessary emails and improves digital communication reliability.

4. Technologies & Tools Used:

- **Programming Language:** Python
- **Libraries:** pandas, scikit-learn, matplotlib, seaborn, streamlit, joblib
- **Development Environment:** Jupyter Notebook, Streamlit

5. Dataset Information:

- Source: spam_email_dataset.csv
- Total records: ~5,500 messages
- Columns used:
 - label (ham/spam)
 - text (email message)

Label Distribution:

- HAM: ~4,827 messages
 - SPAM: ~747 messages
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6. Workflow Overview:

1. **Data Preprocessing:**
 - Dropped duplicates and missing values
 - a. Mapped labels to binary (ham=0, spam=1)
2. **Vectorization:**
 - Used **TF-IDF Vectorizer** to convert text to numeric feature vectors
3. **Model Training:**
 - Used **Multinomial Naive Bayes** classifier
 - Data split: 80% train / 20% test
4. **Model Evaluation:**
 - **Accuracy:** ~96.36%
 - **Confusion Matrix:**
 - True Negatives (HAM → HAM): 965
 - False Positives (HAM → SPAM): 20
 - False Negatives (SPAM → HAM): 25
 - True Positives (SPAM → SPAM): 145
5. **Deployment:**
 - Created an interactive web app using **Streamlit**
 - Features:
 - Upload dataset to retrain model
 - Real-time spam message detection
 - Evaluation metrics shown on sidebar

7. Confusion Matrix Explanation:

- **TN (965):** Correctly classified HAM messages
- **TP (145):** Correctly classified SPAM messages
- **FP (20):** HAM misclassified as SPAM
- **FN (25):** SPAM misclassified as HAM

8. Key Evaluation Metrics:

- **Accuracy:** 96.36%
 - **Precision:** 87.95%
 - **Recall:** 85.29%
 - **F1 Score:** 86.60%
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9. Conclusion:

The spam detection system performs very well with high accuracy and balanced precision/recall. The deployment through Streamlit makes it easy to retrain and test on new datasets.

This project demonstrates how natural language processing and machine learning can effectively solve real-world problems.

10. Future Enhancements:

- Add more classifiers (e.g., Logistic Regression, SVM)
 - Include advanced text preprocessing (stemming, lemmatization)
 - Support multilingual spam detection
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