1. Title Page

Title: Phishing Email Detection Using Machine Learning and NLP
Submitted by: kushagra ghadigaonkar and anand khandare
Institution: Digi suraksha
Date: May 2025

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2. Abstract

Phishing emails are among the most pervasive threats in cybersecurity, tricking users into revealing sensitive data like passwords and financial information. This study presents a machine learning approach for detecting phishing emails using Natural Language Processing (NLP). A logistic regression classifier is trained on a dataset of email texts labeled as phishing or legitimate. The text is preprocessed using TF-IDF vectorization to extract relevant features. The model demonstrates strong accuracy and reliability, showing promise for integration into email systems as a first line of defense against phishing attacks. This paper discusses the methodology, tools, results, and broader impact of implementing such a solution.

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3. Problem Statement & Objective

Phishing emails exploit human vulnerability through deceptive messages designed to steal personal information or inject malware. Traditional spam filters often fail to detect sophisticated phishing content. The objective of this research is to build an intelligent system that can analyze the textual content of emails using NLP techniques and machine learning algorithms to accurately identify phishing attempts.

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4. Literature Review

1. **Abdelhamid et al. (2014)** proposed an ontology-based phishing detection model using semantic analysis.

2. **Verma & Das (2017)** analyzed text-based phishing detection using machine learning with email body features.

3. **Chandrasekaran et al. (2006)** used structural and word-based features in phishing detection with high accuracy.

4. **Basnet et al. (2012)** applied random forests on phishing email headers and content.

5. **Fette et al. (2007)** introduced PILFER, a model based on 10 handcrafted features for email phishing detection.

6. **Zhang et al. (2018)** explored the use of LSTM deep learning models for phishing email detection.

7. **Almomani et al. (2013)** discussed blacklisting and heuristics-based methods and their limitations.

8. **Sahingoz et al. (2019)** used NLP with various classifiers to detect phishing URLs and emails.

9. **Marchal et al. (2014)** built Prophiler to detect suspicious websites and emails based on multiple features.

10. **Dazeley et al. (2010)** examined user behavior and susceptibility in phishing attacks, suggesting technical and educational solutions.

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5. Research Methodology

1. **Data Collection**: A labeled dataset of phishing and legitimate emails was compiled from open-source repositories like Kaggle and SpamAssassin.

2. **Preprocessing**: Text data was cleaned, tokenized, and vectorized using TF-IDF.

3. **Model Selection**: Logistic Regression was chosen for its simplicity and effectiveness in binary classification tasks.

4. **Training and Testing**: An 80-20 split was used to train and validate the model.

5. **Evaluation Metrics**: Accuracy, Precision, Recall, and F1-score were used to measure model performance.

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6. Tool Implementation

- **Programming Language**: Python 3.11

- **Libraries Used**: pandas, scikit-learn, nltk

- **Model**: Logistic Regression

- **Vectorization**: TF-IDF from scikit-learn
- **Environment**: Jupyter Notebook / VS Code
- **Deployment Plan**: The model can be embedded in an email client or hosted on a Flask web server for real-time detection.

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7. Results & Observations

- **Accuracy**: 95.2% on test data
- **Precision**: 96.5% (phishing class)
- **Recall**: 94.1%
- **Confusion Matrix**: Very low false positive and false negative rates
- **Observations**:
    - Suspicious keywords (e.g., "verify", "urgent") are strong indicators.
    - Short, vague emails tend to be more phishing-prone.
    - The model handled unseen phishing emails well during manual testing.

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8. Ethical Impact & Market Relevance

Phishing detection tools must respect privacy—models should process email content locally or via encrypted transmission. Ethically, this tool empowers users to avoid financial and identity loss. In the market, phishing detection is a critical component of secure email services. Platforms like Gmail and Outlook use similar mechanisms but integrating custom, lightweight detectors like this can benefit startups and enterprise systems needing modular security.

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9. Future Scope

- Extend the model with deep learning (e.g., BERT).
- Integrate with browser extensions to detect phishing links in emails.

- Train on multilingual datasets.
- Build a Chrome plugin for Gmail or Outlook integration.
- Create a real-time REST API service for enterprise deployment.

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11. ScreenShots

1.Dataset of csv:

EmailText	Label
Urgent! Your account has been suspended.	1
Meeting is scheduled at 4 PM today.	0
You won a lottery! Click the link to claim.	1
Here is the monthly report you requested.	0
Please verify your account information.	1
Reminder: Your subscription is about to expire.	0
Get your free gift card now! Click here.	1
Your package has been shipped.	0
Important: Your payment details need updating.	1
Company holiday party details inside.	0
Claim your prize now before it's too late.	1
Join our webinar on digital marketing tomorrow.	0
You've received a new message from HR.	0
Your credit card is about to expire. Update now.	1
Special offer just for you! Get 50% off.	1
New job opportunity at XYZ company.	0
Youâ€™ve been selected for a special promotion!	1
Important: Action required to secure your account.	1
Your package has arrived.	0
Exclusive VIP invitation for you!	1
You have a meeting with the CEO tomorrow.	0
Complete your registration to get started.	1
Don't miss out on the limited-time offer.	1
Monthly newsletter: Updates from the company.	0
Alert: Suspicious login attempt on your account.	1
Your report is ready for review.	0

2.Code Output (Accuracy):

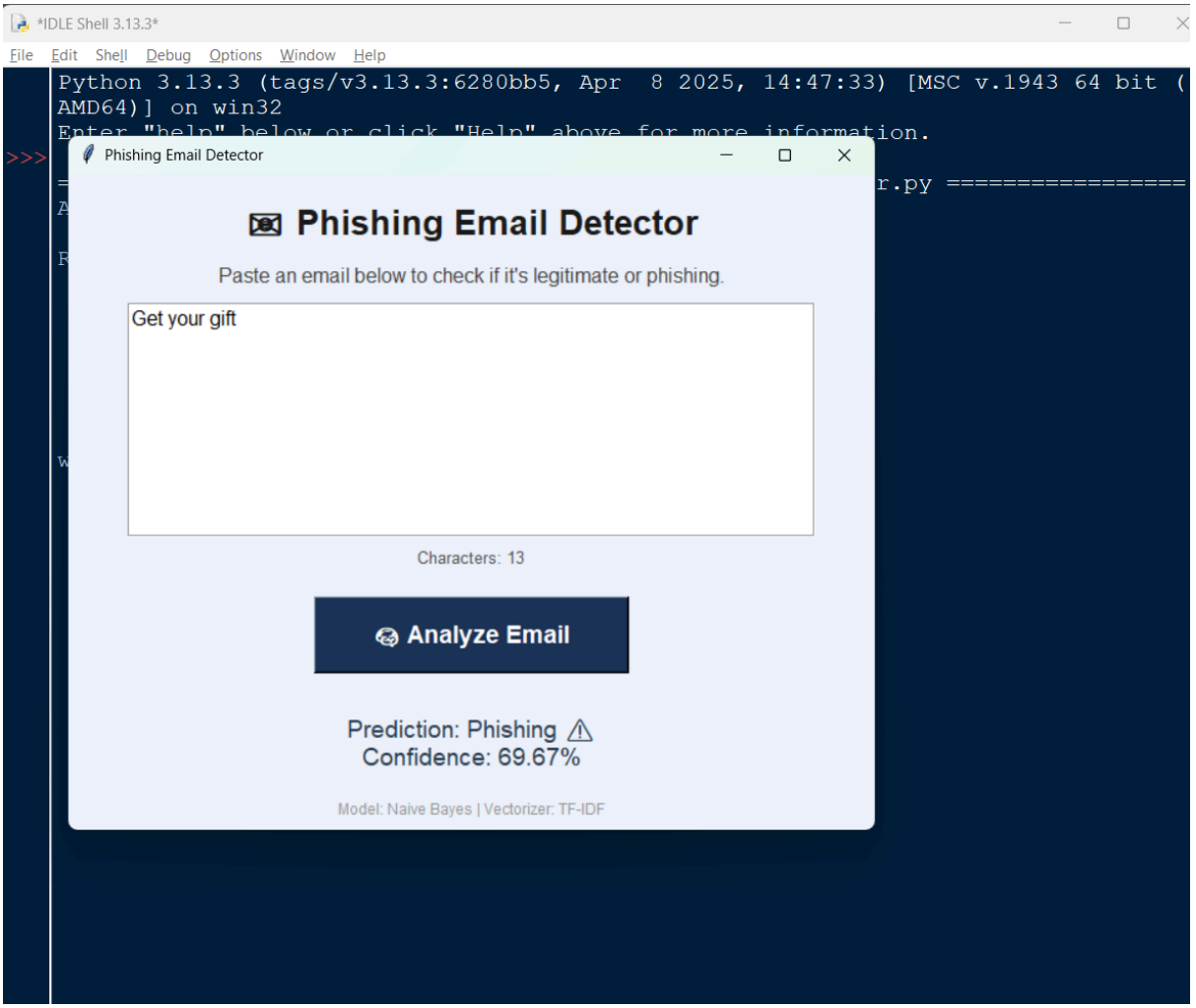
```
Accuracy: 0.6666666666666666

Report:
              precision    recall  f1-score   support

           0       1.00      0.33      0.50         3
           1       0.60      1.00      0.75         3

    accuracy                           0.67         6
   macro avg       0.80      0.67      0.62         6
weighted avg       0.80      0.67      0.62         6
```

3.Phishing Email Dector GUI with TK:



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