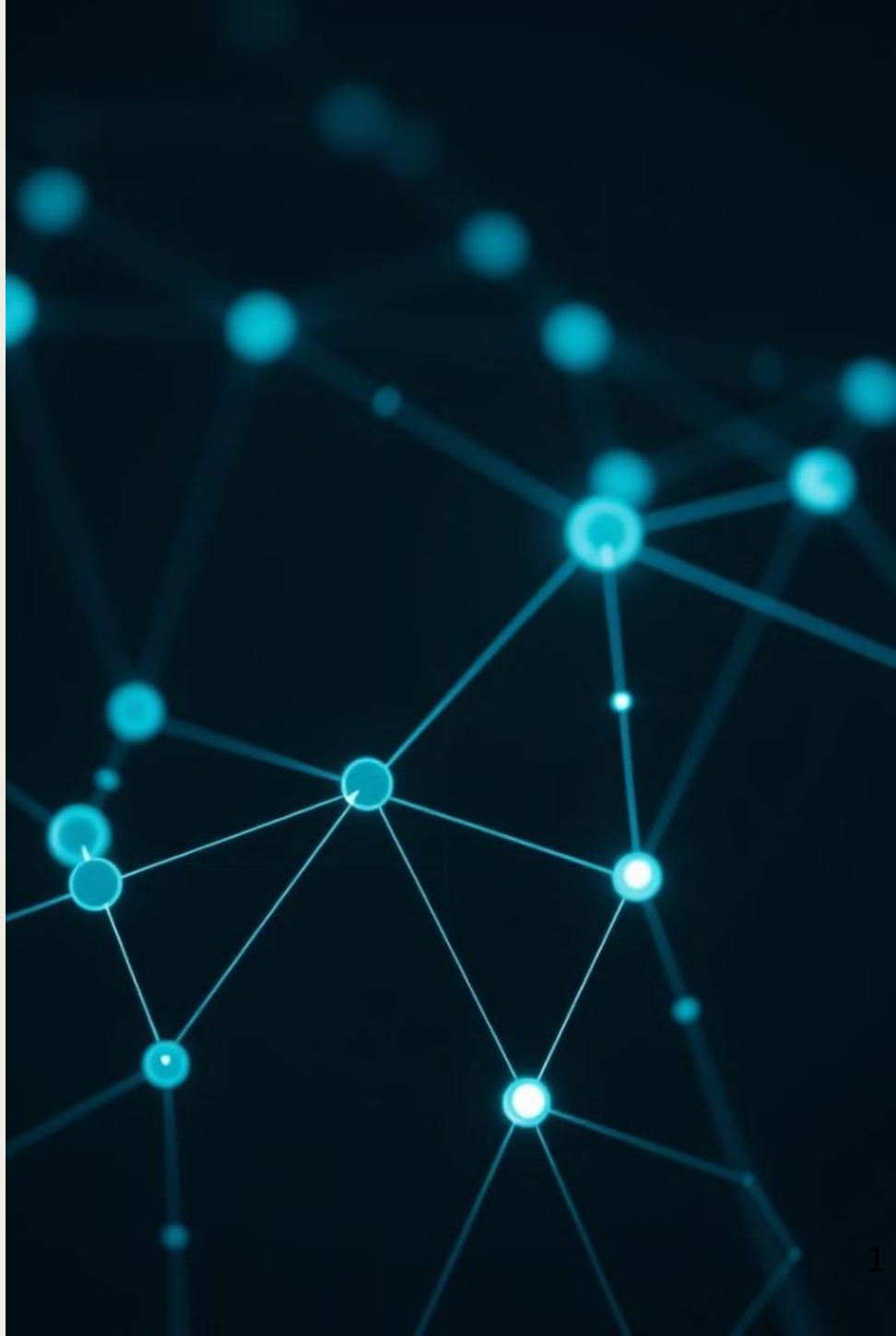
Phishing URL Detection: A Machine Learning Approach



Meet the Team

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Project Objective

Develop a machine learning-based phishing URL detector to enhance cybersecurity.

Goal:

Achieve real-time, high-accuracy phishing detection to protect users and businesses.

What is Phishing?

Deceptive Tactics

- Fraudsters use email, social media, and other online channels to trick users into revealing sensitive information.

Real-World Examples

- Emails impersonating banks, government agencies, and trusted brands are common phishing techniques.

Understanding Phishing Attacks

1 Business Risks

- Financial losses
- reputational damage.

2 Cybercrime Sophistication

- Advanced tactics
- Social engineering.

3 Protection Necessity

- Tools to identify phishing URLs for real-time detection.

Business Objectives

High-Accuracy Detection

User-Friendly Deployment

Real-Time Classification

Expected Impact

1 Financial Security

Reduce financial losses due to phishing scams.

2 User Trust

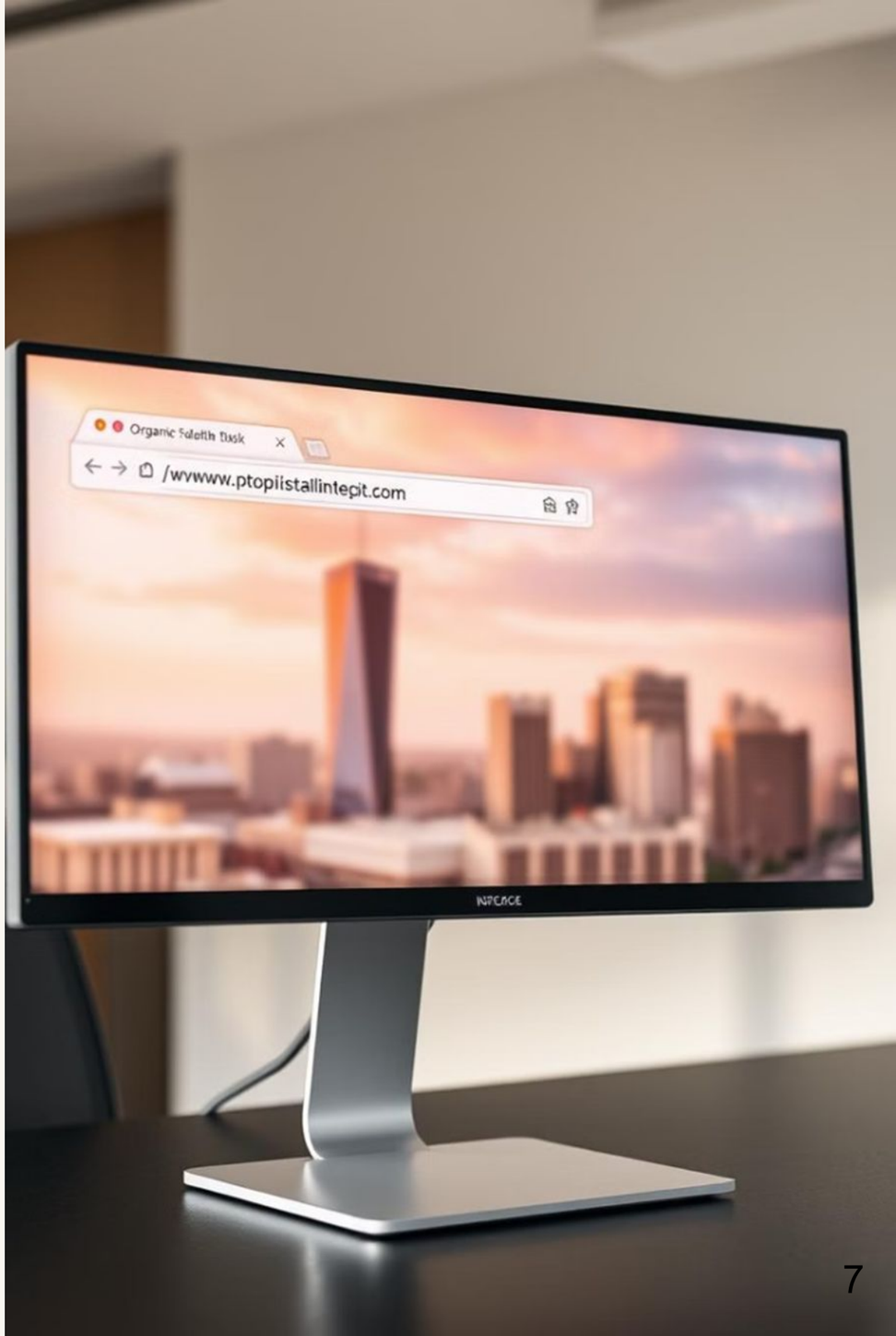
Build confidence in online interactions.

Benefits to Stakeholders

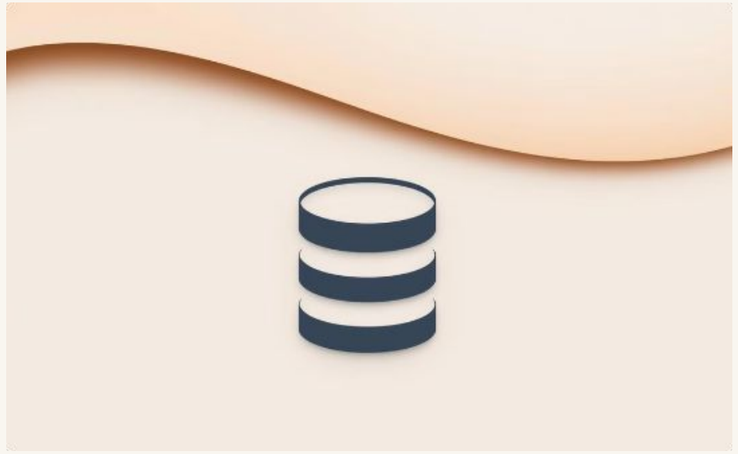
- **Business Users**
  Helps secure business operations by preventing phishing scams, protecting financial data, and ensuring safe online transactions. Example is banking services.

- **Individual Users (General Public)**
  Provides an easy way to avoid phishing attacks and safeguard personal information while browsing the internet.

- **Cybersecurity Teams**
  Supports proactive threat prevention by identifying phishing URLs and integrating into existing security measures.



Data Foundation



Dataset

Mendeley Phishing URL Dataset.

Size

6,568,184 URLs, reduced to 10,000 for analysis.

Preparation

Feature extraction, cleaning, and encoding were performed.

Data Preparation

1

Data Collection

- Gather diverse labelled URLs from Mendeley Dataset .

2

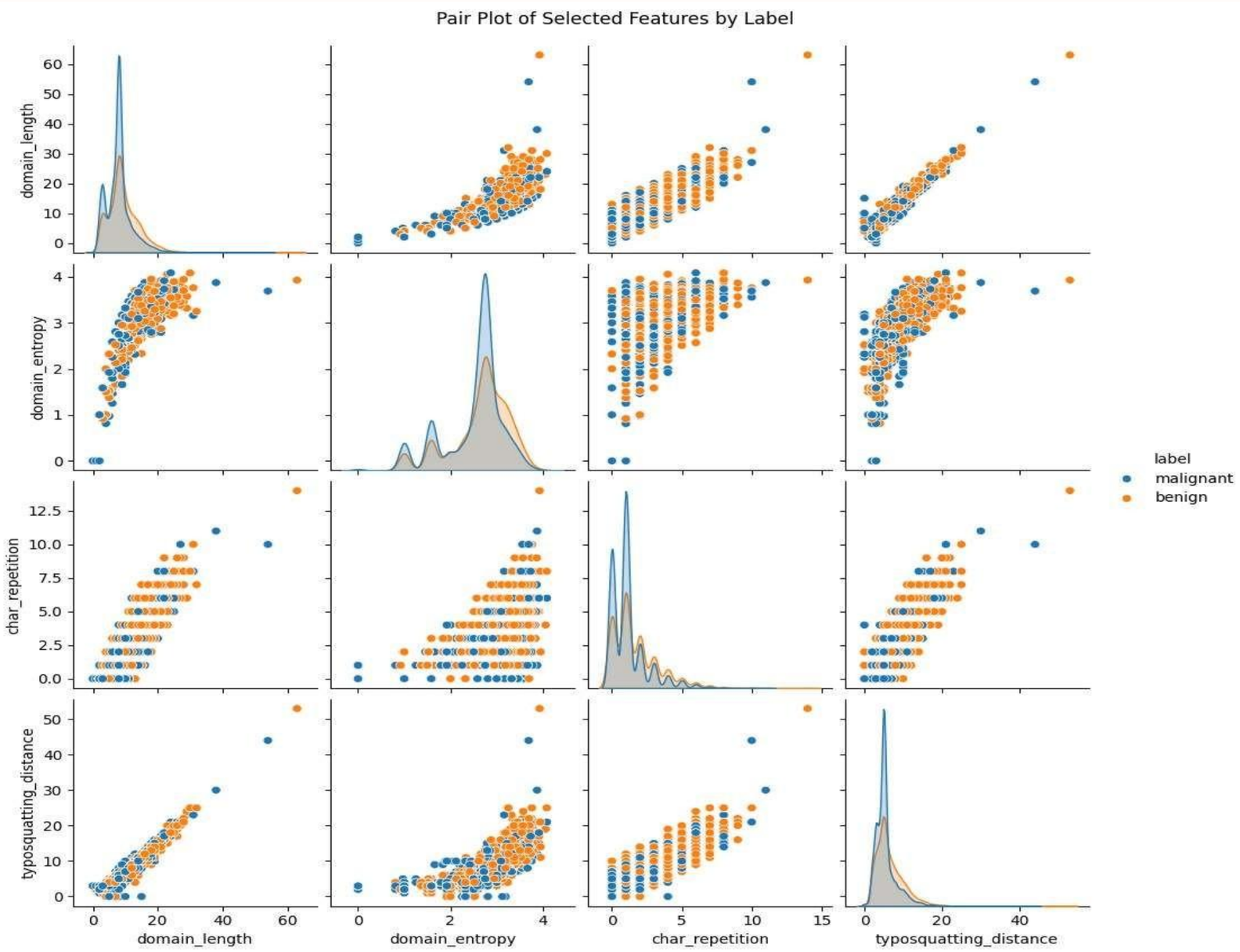
Data Loading

- Loaded the txt data into dataframes

3

Feature Extraction and Engineering

- Extract 45 relevant URL attributes like domain age, URL length, Whois registration



Features

Types of Features:

- structural features e.g. domain length
- content-based features e.g. website title
- security features e.g. domain registration
- similarity features e.g. url similarity score
- randomness indicators e.g. domain entropy.

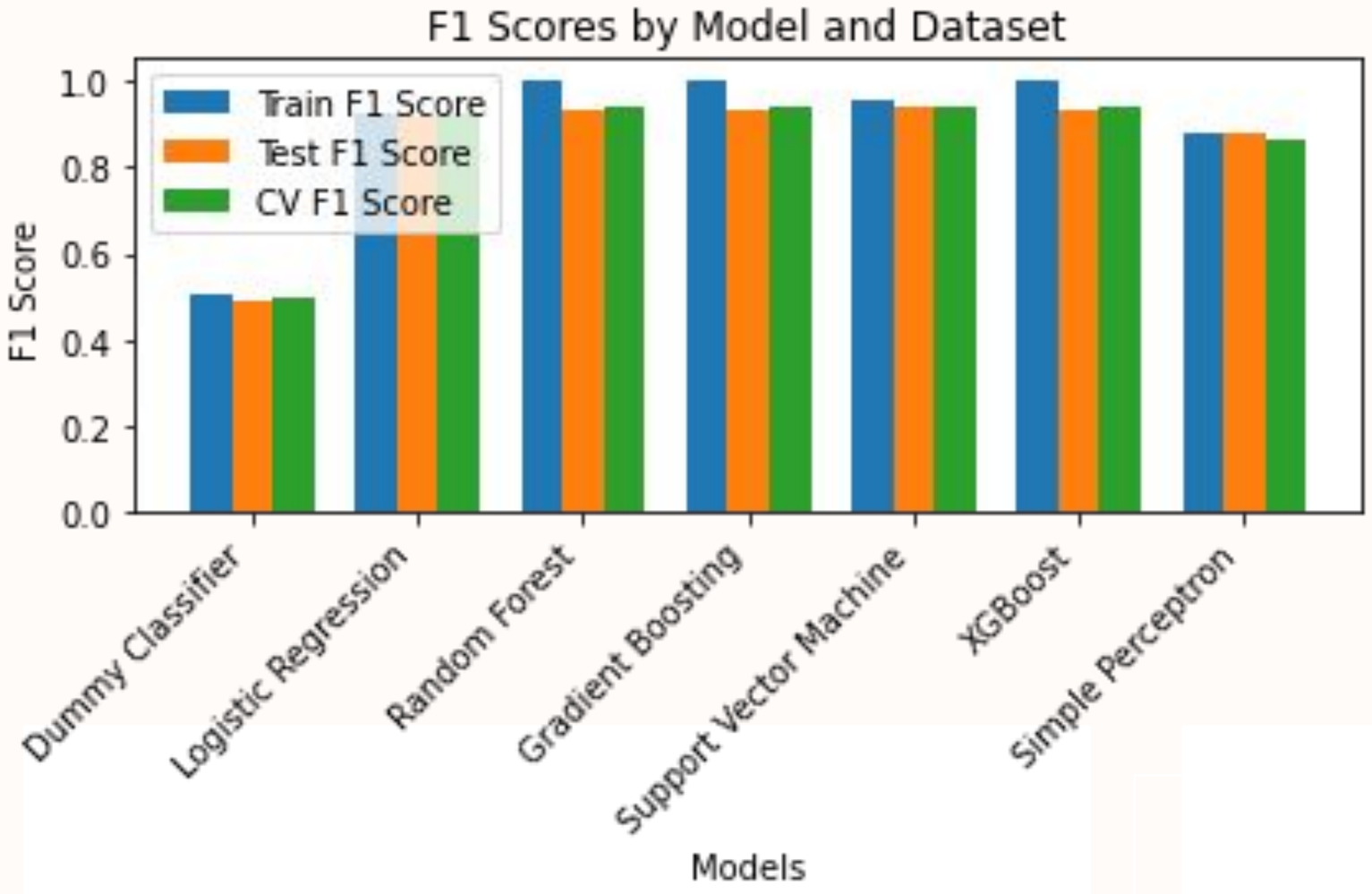
Phishers exploit trust

- Features like domain length, HTTPS presence, and brand names capture these traits.

Obfuscation

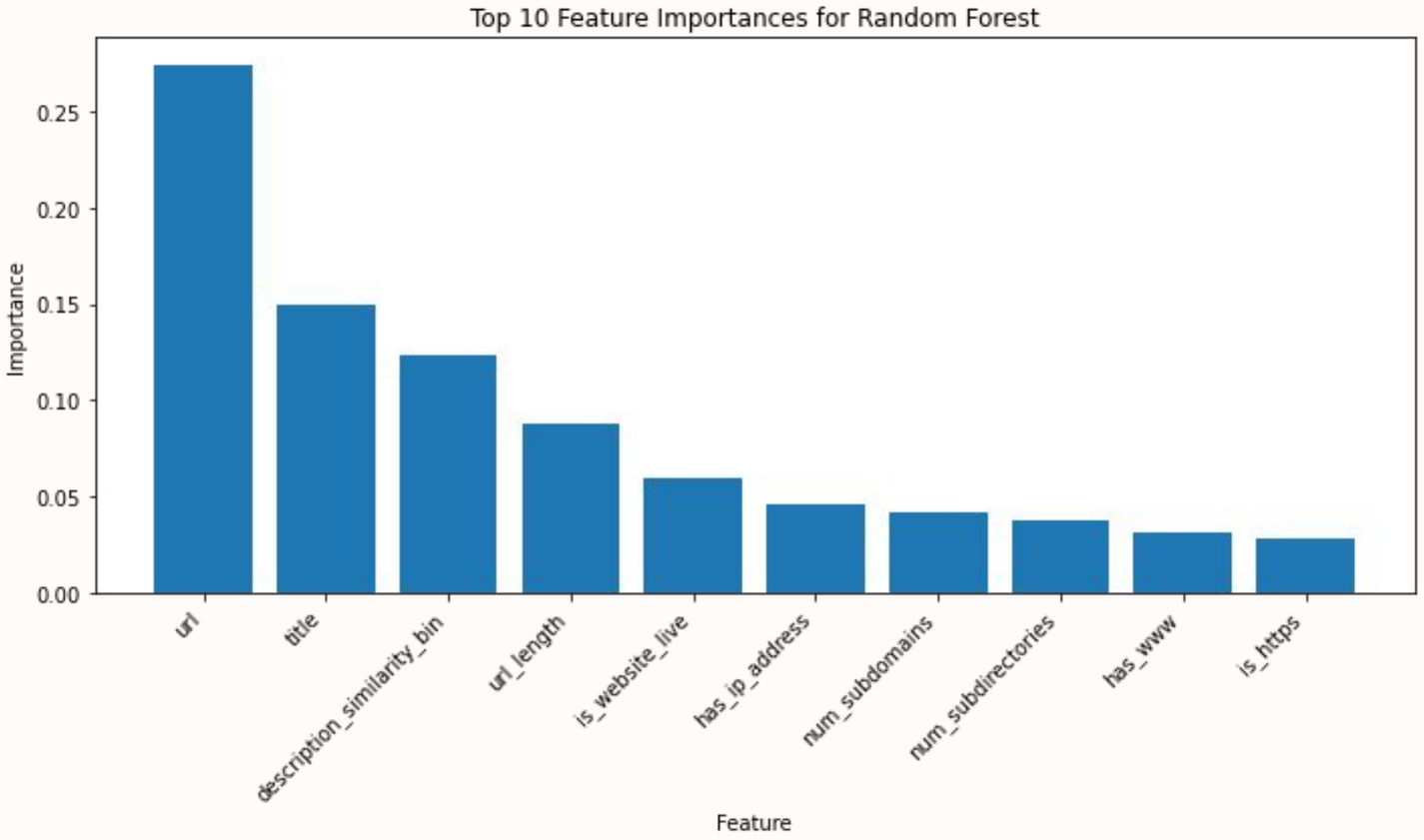
- Features like title, description_similarity, suspicious keywords detect impersonation or buried intent.

Methodology and Modeling



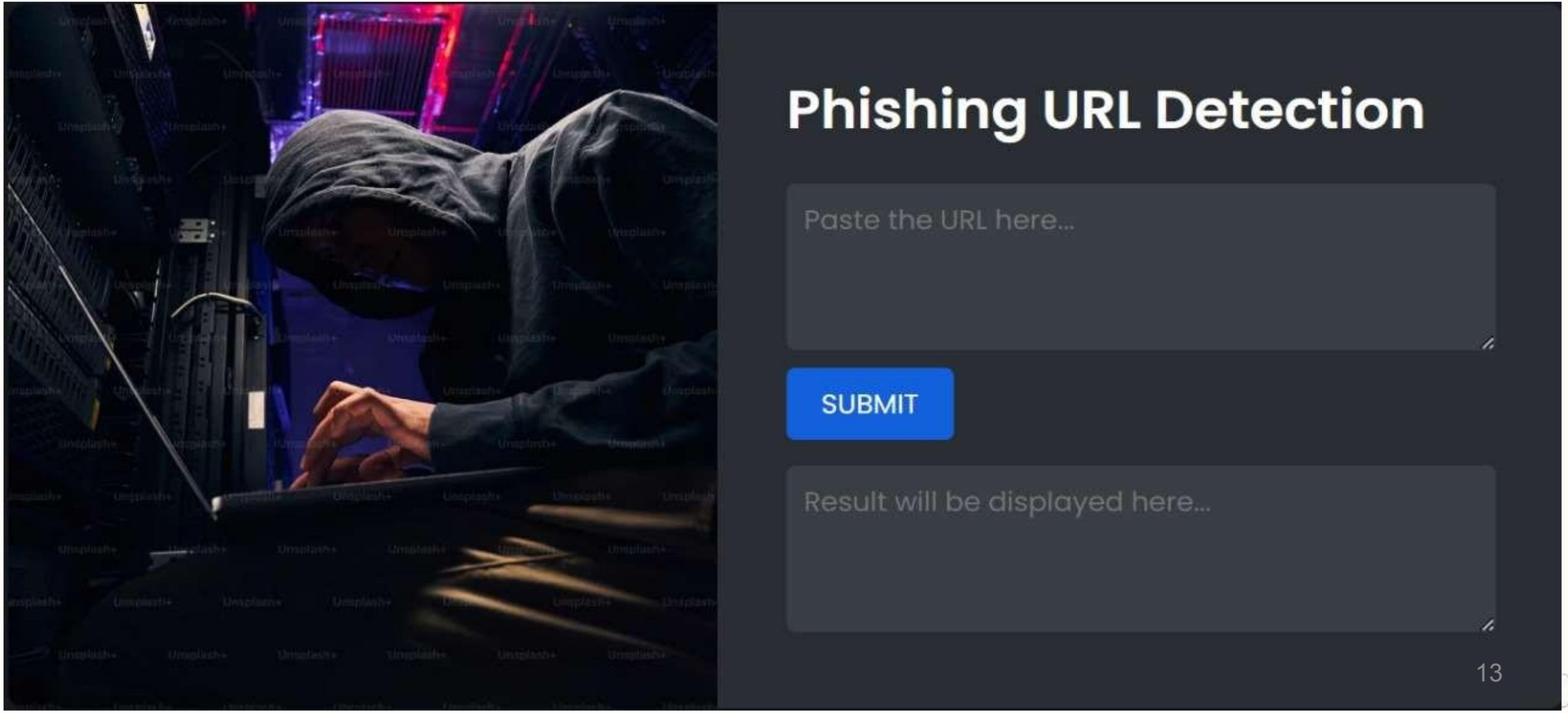
- Iterative approach optimizing precision and recall using F1-scores.
- Used pipelines to make preprocessing and modeling more seamless.
- Incorporated hyperparameter tuning and PCA keeping 95% of the variance which reduced noise and boosted model performance
- Best performing models included SVM followed by Random Forest and boosted models.

Most Important Features



- URL was the most important feature across boosted models and random forests.
- Models seemed to have picked up more patterns from the URLs themselves and our extracted features
- Further feature extraction and engineering would likely improve the models' generalizability and balance precision and recall.

Deploying the Detector



Key Insights

1

Better URL description

Additional feature engineering could help the model learn more patterns from urls rather than from the urls themselves.

2

Hyperparameter Tuning

Tuning hyperparameters enhanced discrimination between phishing and legitimate URLs, improving overall F1 scores.

3

PCA Application

Helped reduce noise and improved model stability especially for complex models like Gradient Boosting and XGBoost.

Challenges and Next Steps

1

Compute Constraints

Scaling to large datasets.

2

Data Augmentation

Gather additional training data.

3

Browser Extension

Remove human in the loop for true real time detection

4

User Feedback

Collect user feedback for improvements.

Technology Stack

Python

Core programming language.

Scikit-learn

Machine learning library.

Pandas

Data manipulation and analysis.

Matplotlib

Data visualization library.

Flask

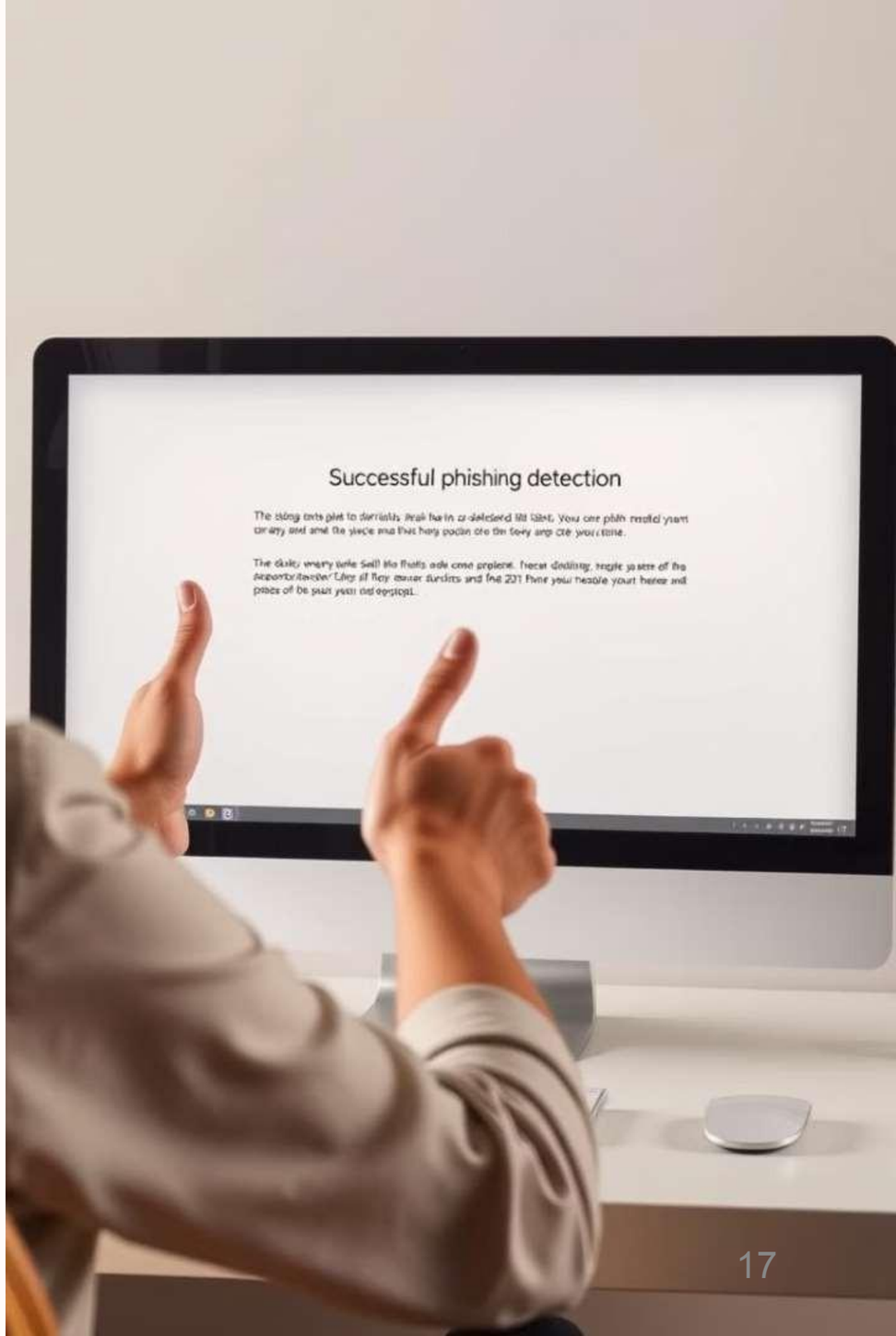
Deployment of a web-based tool

Render

Hosting web application

Conclusion

- High-Accuracy Phishing Detection.
- Balanced F1-Score
- User-Friendly Web Deployment
- Real-Time Classification
- Identify Important Features



Q&A

Thank You