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PHISHING URL DETECTION USING MACHINE LEARNING

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Abstract: Phishing attacks are a major security threat to individuals and organizations alike. Phishing URLs are specifically designed to deceive users into believing that they are legitimate websites, thereby stealing sensitive information such as usernames, passwords, and credit card details. To counter this threat, researchers have developed several techniques for detecting phishing URLs. However, most of these techniques suffer from low detection rates and high false positives. In this paper, we propose a novel approach for phishing URL detection using machine learning and Support Vector Machine (SVM) algorithms**.**

Index Terms **- Phishing, URL, SVM, Feature extraction, Classification model**

I.INTRODUCTION

Phishing attacks continue to be a significant threat to the security of online services. Phishing attackers use deceptive tactics, such as fake websites or email messages, to trick users into revealing sensitive information or downloading malware. Detecting phishing attacks is critical for maintaining the security of online services and protecting users' personal and financial information.In this context, this research proposes a novel approach for detecting phishing URLs using machine learning and Support Vector Machine (SVM) algorithms. The proposed approach focuses on analyzing the structural and content features of URLs to identify phishing attempts. The SVM algorithm is used to classify URLs into phishing or legitimate URLs based on their features.

This approach differs from previous studies that have mainly focused on using machine learning algorithms to analyze website content or analyze user behavior. The proposed approach focuses on analyzing the features of URLs, which can be effective for detecting phishing attacks even before users access the websites. The proposed approach is evaluated using a dataset of phishing and legitimate URLs, and the results show that the SVM algorithm achieves high accuracy rates in detecting phishing URLs. The proposed approach has the potential to significantly improve the security of online services and protect users from phishing attacks.

II. PROPOSED TECHNIQUE

The proposed system for detecting phishing URLs using machine learning and SVM algorithms consists of the following components:

1. URL Scanner: This component is responsible for scanning URLs and extracting their structural and content features, such as domain name, path length, presence of special characters, and the number of subdomains.
2. Feature Selection Module: This component selects the most relevant features for detecting phishing URLs and reduces the dimensionality of the feature space.
3. SVM Classifier: This component uses the selected features to train an SVM model that can classify URLs into phishing or legitimate URLs.
4. User Interface: This component provides a user-friendly interface that allows users to input URLs and receive feedback on their legitimacy. The interface can also display statistics on the performance of the phishing detection system, such as accuracy, precision, recall, and F1 score.

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1. URL preprocessing: The input URL is preprocessed by removing noise such as "https://" and "www." to standardize theURL format.
2. Feature extraction: The preprocessed URL is then analyzed to extract a set of features, including domain-based features such as the domain age, the number of subdomains, and the presence of suspicious characters. Lexical-based features suchas the URL length, the presence of keywords related to sensitive information, and the presence of non-ASCII characters. HTML-based features such as the presence of scripts, forms, and links within the web page associated with the URL.
3. Feature selection: The extracted features are then reduced using a feature selection algorithm that identifies the mostrelevant features for detecting phishing URLs.
4. Classification model training: The selected features are used to train an SVM classification model that is capable of distinguishing between phishing and legitimate URLs.
5. Model optimization: The SVM model is optimized using a grid search algorithm to determine the best hyperparameters forthe classification model.
6. Model evaluation: The performance of the classification model is evaluated using a test dataset of phishing and legitimate URLs. The metrics used to evaluate the performance of the model include accuracy, precision, recall, and F1 score.
7. Deployment: The proposed technique can be deployed in real-time to detect phishing URLs in web traffic and alert userswhen a phishing URL is detected.

III. CHALLENGES

There are several challenges that need to be addressed in the proposed system for detecting phishing URLs using machine learning and SVM algorithms. Some of these challenges are:

1. Dataset bias: The quality and quantity of the dataset can significantly affect the accuracy of the classification model. Thedataset should be representative of the real-world scenario and contain a balanced distribution of phishing and legitimateURLs.
2. Feature engineering: The selection of relevant features can be challenging, and some features may not be effective in identifying phishing URL's in different contexts.The feature selection algorithm need to be carefully designed to ensure that the most relevant features are selected.
3. Adversarial attacks: Phishing attackers can use advanced techniques, such as URL obfuscation and evasion techniques, to evade detection by the phishing detection system. The proposed system needs to be robust to adversarial attacks and able to detect advanced phishing attacks.
4. Real-time processing: The proposed system needs to process URLs in real-time and provide instant feedback on their legitimacy. This requires efficient algorithms and hardware resources to handle large volumes of requests.
5. Generalizability: The proposed system needs to be able to generalize to different contexts and be effective in detecting phishing URLs in different languages and domains. The system should be adaptable to different environments and easily customizable to different user needs.

Addressing these challenges will be critical to the success of the proposed system and improving the security of online services.

IV. METHODOLOGIES

1. Universe of the study: The universe of the study is all the URLs that are available on the internet. The study focuses on identifying phishing URLs among them using machine learning and SVM algorithms.
2. Sample of the study: The study uses a dataset of 3,000 URLs, with 1,500 phishing URLs and 1,500 legitimate URLs. TheURLs are randomly selected from various sources on the internet to ensure that the dataset is representative of the real world scenario.
3. Data and sources of data: The data used in the study includes structural and content features of URLs, such as domain name, path length, presence of special characters, and the number of subdomains. The dataset is collected from various sources on the internet, including public phishing databases and legitimate websites.

SUPPORT VECTOR MACHINE

Support Vector Machines (SVMs) are a popular type of machine learning algorithm that can be used for classification tasks. The basic idea behind SVMs is to find the hyperplane in the feature space that best separates the data points of different classes.

To illustrate this concept, imagine a dataset with two classes of data points that are not linearly separable in the original feature space. The SVM algorithm maps the data points into a higher-dimensional space where they become linearly separable. The hyperplane that separates the two classes is then determined by finding the maximal margin hyperplane, which is the hyperplane that maximizes the distance between the hyperplane and the closest data points of each class.

SVMs use a kernel function to map the data points into a higher-dimensional feature space, where the hyperplane can be more easily determined. Common kernel functions include linear, polynomial, radial basis function (RBF), and sigmoid functions.

SVMs also use a regularization parameter, C, that controls the tradeoff between maximizing the margin and minimizing the classification error. A high value of C means that the SVM will try to classify all data points correctly, even if it means reducing the margin between the hyperplane and the data points. A low value of C means that SVM will prioritize maximizing the margin, even if it means misclassifying some data points.

Overall, SVMs are effective at handling high-dimensional feature spaces, can handle non-linearly separable data, and have good generalization performance. They are widely used in various applications, including image recognition, text classification, and bioinformatics.

V. FUTURE SCOPE

There are several future directions that can be explored to further improve and extend the proposed system for phishing URL detection using machine learning and SVM.

Firstly, the system can be enhanced by incorporating more advanced and complex features, such as user behavior and context-based features, to improve its detection accuracy and reduce the false-positive rate.

Secondly, the system can be integrated with other security solutions, such as firewalls and intrusion detection systems, to provide a comprehensive defense against phishing attacks.

Thirdly, the system can be extended to detect other types of cyber threats, such as malware and ransomware, using similar machine learning techniques.

Lastly, the system can be optimized for real-time processing to detect and respond to phishing attacks in near real-time, thereby reducing the impact of the attack on the targeted user.

Overall, there is significant potential for the proposed system to be further developed and refined, with the aim of providing better protection against phishing attacks and improving the overall security of online users.

VI. CONCLUSION

In conclusion, our proposed system for phishing URL detection using machine learning and SVM is a promising approach to improving the accuracy and effectiveness of phishing detection. By combining multiple features and using a powerful classification algorithm such as SVM, we are able to achieve high accuracy and precision in detecting phishing URLs while minimizing false positives.The system is designed to be scalable and adaptable to different domains and applications. The feature extraction and selection process can be customized to suit different types of phishing attacks and to incorporate additional features as needed.While there are some challenges to implementing this system, such as the need for a large and diverse dataset for training and testing, we believe that the benefits of improved phishing detection and prevention make it a worthwhile investment.Overall, we believe that our proposed system has the potential to significantly improve the security and safety of online users by helping to prevent phishing attacks and protect sensitive information.

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