

Phishing Detection in Browsers using Machine Learning

Tanmay Naik

*Khoury College of Computer Sciences
Northeastern University
Boston, US
naik.t@northeastern.edu*

Nithin Gangadharan

*Khoury College of Computer Sciences
Northeastern University
Boston, US
gangadharan.n@northeastern.edu*

Abstract—Phishing is a cybercrime in which a target visits a website that is posing as a legitimate application, to lure individuals into providing sensitive data such as - banking and credit card details, and passwords. An unsuspecting user can click a link in an email or social media platform, and be led to a phishing website, leading to frauds and identity thefts. Phishing is a widespread attack that still does not have a concrete solution.

This report proposes a solution for the protection of end users through a browser extension while comparing various Machine Learning approaches to identify phishing websites. // TODO add "the most important results and findings"

I. INTRODUCTION

With the recent advancement in various cybersecurity technology, the weakest link in the cybersecurity happen to be the end users. Attackers utilize phishing which exploits naivety of users to trick them into handing out sensitive information. This poses a great risk not only to the users themselves but the organizations and institutions of which they are a part of. According to recent research from Proofpoint, 75% of organizations around the world experienced a phishing attack in 2020, and 74% of attacks targeting US businesses were successful.¹

Apart from increasing security awareness among users, we must develop tools which complement that awareness to help them make safe decisions. This report proposes and demonstrates a Chromium-based browser extension to help mitigate the risk of phishing while browsing the web. The central idea of the browser extension is to notify the user whenever they open any *potential* phishing website.

The solution also includes a Python web server which utilizes various Machine Learning classification techniques to determine the legitimacy of the webpage in question. The web server takes in a URL and returns a boolean value indicating if the given URL is part of a potential phishing attempt.

The browser extension monitors each URL that the user visits, and tries to determine if the URL is malicious with the help of the web server. The web server exposes a REST API which is consumed by the extension for communication. The same API can also be reused as-is to implement a similar phishing detection in a different context like a network-level application or in a mobile application like Android.

//TODO "summary of experimental results which is more fine-grained than abstract."

II. RELATED WORK

a) *PhishDetector*²: This too is a Chromium extension which has set out to solve exactly the same problem as this project. Based to its description on the website and the analysis of its behavior, it can be concluded that this extension uses a rule-based system to determine if a webpage is a phishing attempt. It also seems to be particularly accurate when it comes to identifying illegitimate banking pages. Even though rule-based systems are great for detecting simple phishing attempts, they are not ideal for more sophisticated phishing attempts. Rule-based systems are also inherently complex to maintain - adding and modifying rules over time makes the system more complex and unmanageable with time. They also demand more human intervention to define the rules and for their maintenance. Using Machine Learning in lieu of rule-based system gets rid of many of these limitations. As Machine Learning is data centric, it doesn't require managing complex rules and makes it straightforward to tweak the algorithms.

b) *Cloudphish*³: Cloudphish is a phishing detector for web-based email software. It monitors all emails received by a user and checks each email for a phishing attack. Having a paid subscription model, it offers a *decent* service. But the major limitation it has is that it works only with the email inbox. Even though many of the phishing attacks are carried over through email, phishing is as prominent on social media and messaging apps in this age. And that calls for a solution which monitors all the web activity to identify phishing attacks regardless of their method of delivery.

There are various other browser extensions which virtually have the same limitations as the aforementioned solutions⁴⁵⁶ As their limitations are encompassed in the discussion of other solutions above, their detailed discussion has been omitted for brevity.

III. APPROACH

The architecture of this project consists of two primary components: The browser extension and the web server.

a) *Browser Extension*: The extension is developed for Chromium-based browsers using JavaScript with HTML and CSS. Therefore it is compatible with any Chromium implementation including Google Chrome, Microsoft Edge, Brave, etc. The extension monitors each web page that is visited

by the user and fetches the URL of that webpage. It then communicates with the web server which tells if the given URL is part of a phishing attempt or not. The user is notified with the results of the analysis based on the response from server. The extension will stay silent in the background while the user is only visiting safe sites. It only *bothers* them when there is a potential of phishing on the site they are currently visiting with an option to view detailed information to help them make a safer decision.

b) *Python Web Server*: The web server has an REST endpoint which takes in a URL and uses various Machine Learning techniques to classify it into "spam" and "not spam" categories.

IV. EXPERIMENTS AND RESULTS

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V. CONCLUSION AND FUTURE WORK

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VI. APPENDICES

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VII. CONTRIBUTIONS

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