SBM COLLEGE OF ENGINEERING AND TECHNOLOGY

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PROJECT

WEB PHISHING DETECTION

DONE BY

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Project Report

1. INTRODUCTION

Project Overview

Phishing can be defined as impersonating a valid site to trick users by stealing their personal data comprising usernames, passwords, accounts numbers, national insurance numbers, etc. Phishing frauds might be the most widespread cybercrime used today. There are countless domains where phishing attack can occur like the online payment sector, webmail, financial institutions, file hosting or cloud storage and many others. The webmail and online payment sector was embattled by phishing more than in any other industry sector. Phishing can be done through email phishing scams and spear phishing hence user should be aware of the consequences and should not give their 100 percent trust on common security application. Machine Learning is one of the efficient techniques to detect phishing as it removes drawback of existing approach.

Purpose

The objectives which is the most vital thing in proposed project is to verify the validity of the website by capturing blacklisted URLs. To notify the user on blacklisted website through pop-up while they are trying to access and to notify the user on blacklisted website through email while they are trying to access. This proposed project will allow administrator to add blacklisted URL's in order to alert user during their inquiry.

The two scope of project, which is well known as user scope and system scope. User has some responsibility towards the system. The system includes a few standards and policies that requires to be obliged in order to comply the system. The user can be notified if blacklisted website is being accessed. The admin can capture the blacklisted URL's to alert user. The system involves features like capturing blacklisted website, viewing blacklisted website, displaying pop-up notification and also displaying email notification.

2. LITERATURE SURVEY

Existing problem

Couple of researchers have analysed the stats of malicious sites in some way. Our method picks up some of the important ideas from previous case studies. Ma, et al. [3,4] compared various batch-based learning algorithms used in classifying phishing sites and stated that a combination of host based and lexical-based features outcome in the highest accuracy in classification. Besides, they are also compared with the performance of batch-based algorithms with the online-based algorithms which when utilizes complete features and noticed that online-based algorithms, especially Confidence-Weighted (CW), stand out performing batch-based algorithms. The attributes include the existence of the red flag keywords present in the website, attributes that are based on Google's Page Rank and Google's Web page quality guidelines. One cannot compare directly without access to the same websites and attributes.

References

[1] Matthew Dunlop, Stephen Groat, David Shelly (2010) " GoldPhish: Using Images for Content-Based Phishing Analysis”

[2] Rishikesh Mahajan (2018) “Phishing Website Detection using Machine Learning Algorithms”

[3] Purvi Pujara, M. B.Chaudhari (2018) “Phishing Website Detection using Machine Learning : A Review”

[4] David G. Dobolyi, Ahmed Abbasi (2016) “PhishMonger: A Free and Open Source Public Archive of Real-World Phishing Websites”

[5] Satish.S, Suresh Babu.K (2013) “Phishing Websites Detection Based On Web Source Code And Url In The Webpage”

Problem Statement Definition

Phishing detection techniques do suffer low detection accuracy and high false alarm especially when novel phishing approaches are introduced. Besides, the most common technique used, blacklist-based method is inefficient in responding to emanating phishing attacks since registering new domain has become easier, no comprehensive blacklist can ensure a perfect up-to-date database. Furthermore, page content inspection has been used by some strategies to overcome the false negative problems and complement the vulnerabilities of the stale lists.

Moreover, page content inspection algorithms each have different approach to phishing website detection with varying degrees of accuracy. Therefore, ensemble can be seen to be a better solution as it can combine the similarity in accuracy and different error-detection rate properties in selected algorithms. Therefore, this study will address a couple of research:

1. How to process raw dataset for phishing detection?

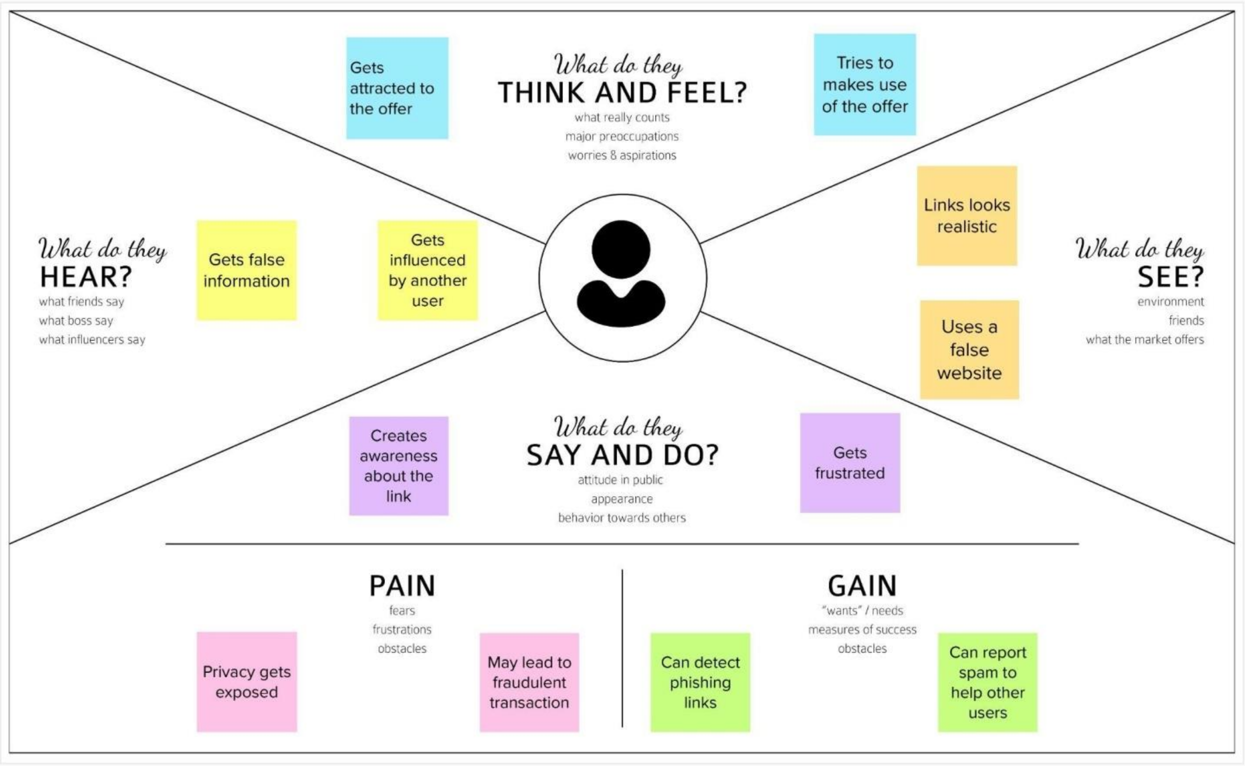
2. How to increase detection rate in phishing websites algorithms?

3. How to reduce false negative rate in phishing websites algorithm?

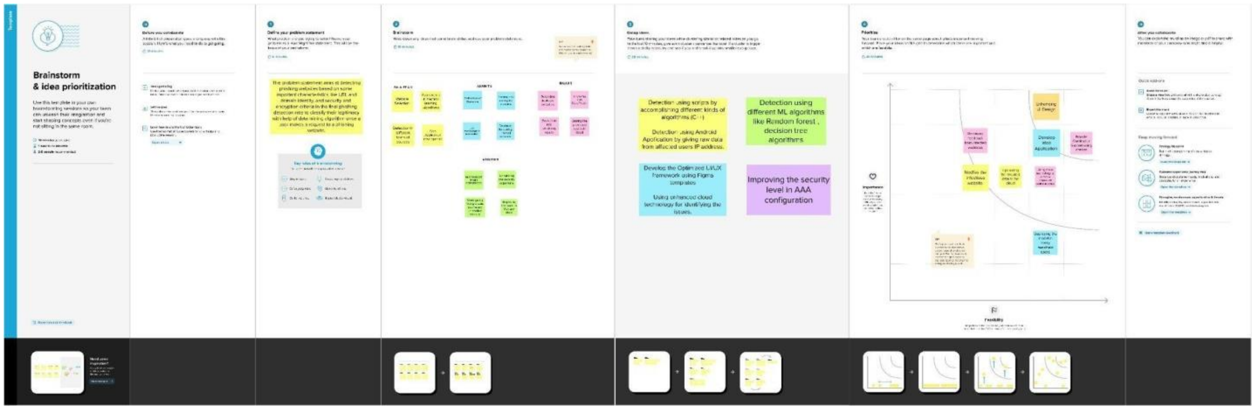
4. What are the best compositions of classifiers that can give a good detection rate of phishing website?

3. IDEATION & PROPOSED SOLUTION

Empathy Map Canvas



Ideation & Brainstorming

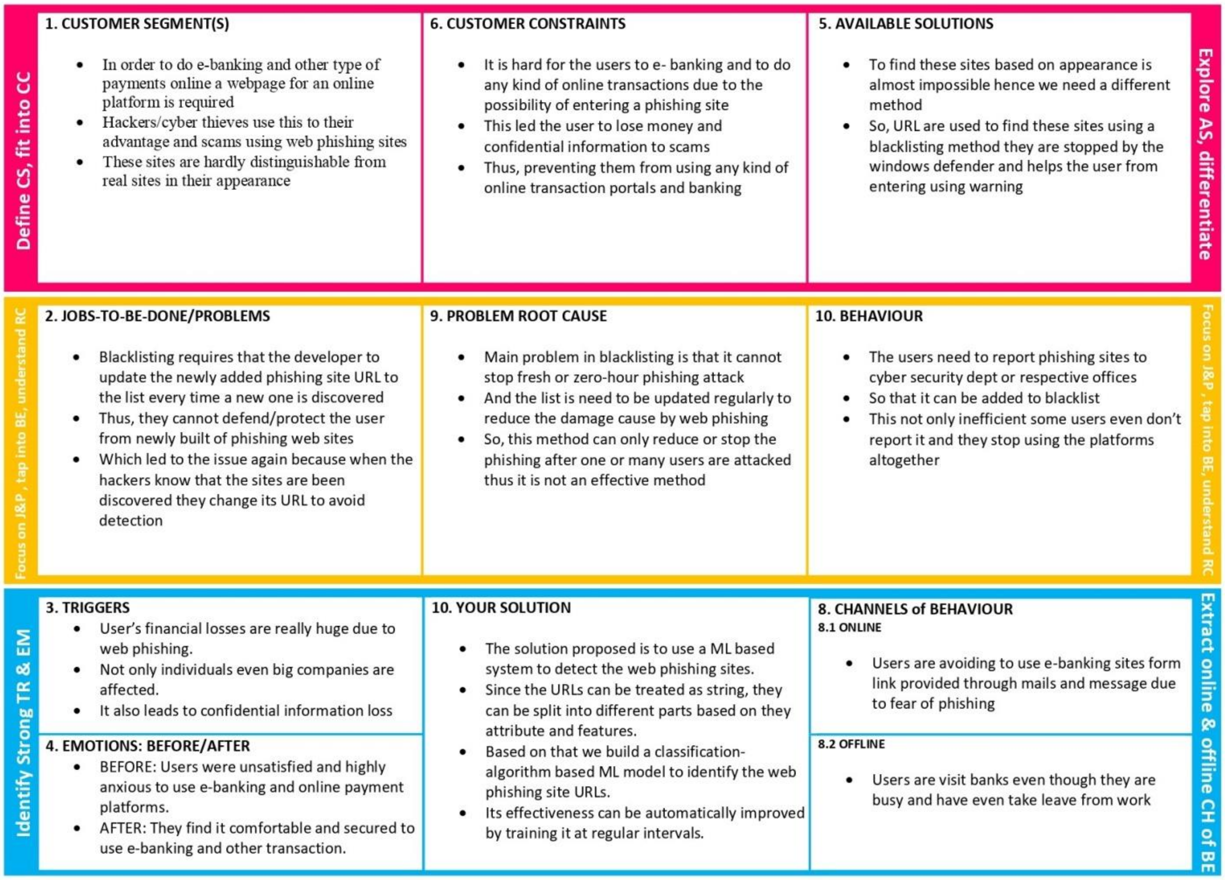

Brainstorm
& idea prioritization
Detection using scripts by accomplishing different kinds of algorithms (C++)
Detection using Android Application by giving raw data from affected users IP address.
Detection using different ML algorithms like Random forest , decision tree algorithms
Develop the Optimized LINUX framework using Figma templates
Using enhanced cloud technology for identifying the issues.
Improving the security level in AAA configuration

Proposed Solution

S. No.	Parameter	Description
1.	**Problem Statement (Problem to be solved)**	Web phishing tends to steal a lots of information from the user during online transaction like username, password, important documents that has been attached to that websites. One of the many security risks to web services on the Internet is web phishing. There are Multiple Types of Attacks happens here every day, but there is no auto detection Process through Machine Learning is achieved
2.	**Idea / Solution description**	Through ML and data mining techniques like classification algorithm user can able to attain a warning signal to notify these phishing websites which helps the user to safeguard their identities and their login credentials etc. python is the language that helps to enable these techniques for the online users Using the results obtained safe websites for online transactions are acquired which would then be made accessible to the users through an online application.

3.	**Novelty / Uniqueness**	This project not only able to identify the malicious websites it also has the ability to automatically block these kind of websites completely in the future when it has been identified and also blocks some various mails /ads from these malicious websites
4.	**Social Impact / CustomerSatisfaction**	This web phishing detection project attainsthe customer satisfaction by discarding various kinds of malicious websites to protect their privacy. This project is not onlycapable of using by an single individual ,a large social community and a organization can use this web phishing detection to protect their privacy. This project helps toblock various malicious websites simultaneously.
5.	**Business Model (Revenue Model)**	This developed model can be used as an enterprise applications by organizations which handles sensitive information and also can be sold to government agencies to prevent the loss of potential important data.Based on membership levels, different levels of security strictness and multiple volumes of secure e-commerce websites would be offered.
6.	**Scalability of the Solution**	This project’s performance rate will be high and it also provide many capabilities to the user without reducing its efficiency to detect the malicious websites. thus scalability of this project will be high.It could be further extended for other security concerns such as audio recording, video recording, location tracking, virus attacks and more.with safer and more effective solutions.

Problem Solution fit


Define CS, fit into CC
Explore AS, differentiate
Focus on J&P , tap into BE, understand RC
Focus on J&P , tap into BE, understand RC
Identify Strong TR & EM
Extract online & offline CH of BE

1. CUSTOMER SEGMENT(S)

- In order to do e-banking and other type of payments online a webpage for an online platform is required
- Hackers/cyber thieves use this to their advantage and scams using web phishing sites
- These sites are hardly distinguishable from real sites in their appearance

6. CUSTOMER CONSTRAINTS

- It is hard for the users to e- banking and to do any kind of online transactions due to the possibility of entering a phishing site
- This led the user to lose money and confidential information to scams
- Thus, preventing them from using any kind of online transaction portals and banking

5. AVAILABLE SOLUTIONS

- To find these sites based on appearance is almost impossible hence we need a different method
- So, URL are used to find these sites using a blacklisting method they are stopped by the windows defender and helps the user from entering using warning

2. JOBS-TO-BE-DONE/PROBLEMS

- Blacklisting requires that the developer to update the newly added phishing site URL to the list every time a new one is discovered
- Thus, they cannot defend/protect the user from newly built of phishing web sites
- Which led to the issue again because when the hackers know that the sites are been discovered they change its URL to avoid detection

9. PROBLEM ROOT CAUSE

- Main problem in blacklisting is that it cannot stop fresh or zero-hour phishing attack
- And the list is need to be updated regularly to reduce the damage cause by web phishing
- So, this method can only reduce or stop the phishing after one or many users are attacked thus it is not an effective method

10. BEHAVIOUR

- The users need to report phishing sites to cyber security dept or respective offices
- So that it can be added to blacklist
- This not only inefficient some users even don't report it and they stop using the platforms altogether

3. TRIGGERS

- User's financial losses are really huge due to web phishing.
- Not only individuals even big companies are affected.
- It also leads to confidential information loss

4. EMOTIONS: BEFORE/AFTER

- BEFORE: Users were unsatisfied and highly anxious to use e-banking and online payment platforms.
- AFTER: They find it comfortable and secured to use e-banking and other transaction.

10. YOUR SOLUTION

- The solution proposed is to use a ML based system to detect the web phishing sites.
- Since the URLs can be treated as string, they can be split into different parts based on they attribute and features.
- Based on that we build a classification-algorithm based ML model to identify the web phishing site URLs.
- Its effectiveness can be automatically improved by training it at regular intervals.

8. CHANNELS of BEHAVIOUR

8.1 ONLINE

- Users are avoiding to use e-banking sites form link provided through mails and message due to fear of phishing

8.2 OFFLINE

- Users are visit banks even though they are busy and have even take leave from work

4. REQUIREMENT ANALYSIS

Functional requirement

FR No.	Functional Requirement(Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Learning & Detection	The samples and the topological structure of the machine learning TensorFlow is built. The submitted URLs are tested against thesamples in the database to perform classification.

FR-2	Testing & Alert	URLs passed through the system are recorded in a database, thus each URL submitted by the user is tested to check or duplicate. If a phishing website is detected the popup message will alert the user. Give information about the malicious website with accurate result.
FR-3	Deep Learning	The phishing detection process could be doneusing the Recurrent Neural Network.The website could bedetected.
FR-4	Hardware Requirements	2GB RAM(minimum) 100GB HDD(minimum) Intel i3 quad core 1.66GHz processor(minimum) Internet Connectivity
FR-5	Software Requirements	Windows 7 or higher Python 3.6.0 or higher Visual Studio Code Flask(python platform) HTML Dataset consisting of Phishing websites and their features. Required plugins and libraries Jupiter notebook
FR-6	Other requirements	IBM cloud login Chrome extension features

Non-Functional requirements

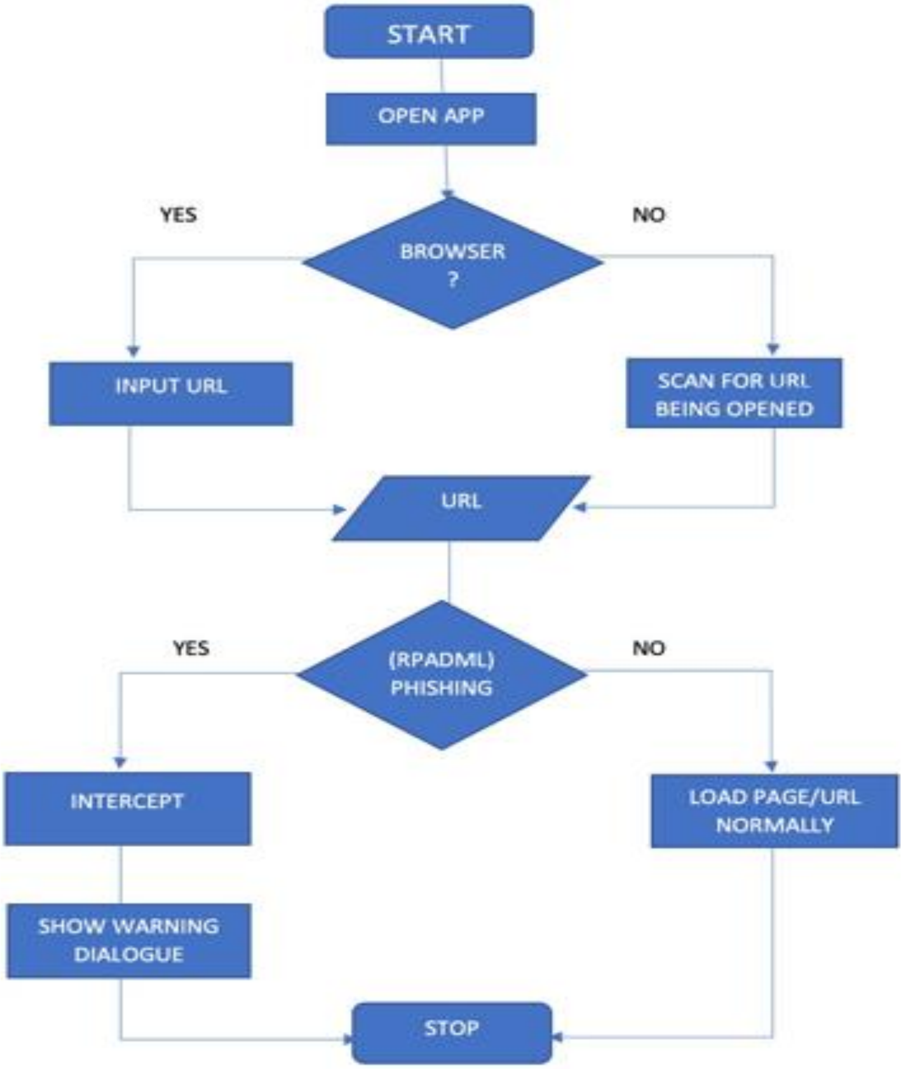
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	This system is really used as it can able to detect phishing websites. By detecting malicious websites, our personal and professional data are confidential, secure, and accessible.

NFR-2	**Security**	Phishers spoof legitimate emails so that the victim trusts them. They send out massive numbers of fraudulent emails in order to catch a smallpercentage of recipients off guard. They create a sense of urgency so that the victim does not think twice before clicking the link or downloading the attachment. Lack of security awareness among employeesis also one of the major reasons for the success of phishing. Organizations should be aware of how the benefits and purpose of security awareness training can secure their employees from falling victim to phishing attacks.
NFR-3	**Reliability**	The performance of the system wouldbe accurate. Probability of giving false information is verylow. As the system is working based on the deep learning algorithm, it would easily predict and give the perfect information.
NFR-4	**Performance**	The effectiveness of these methods relies on feature collection, training data, and classification algorithms and giving alerts when phished websites are detected. It must be processed and executed within a fraction of a second using the deep learning algorithm
NFR-5	**Availability**	The availability of the solution is effective and it should be helpful in a great way to prevent our personal data to be exposed.

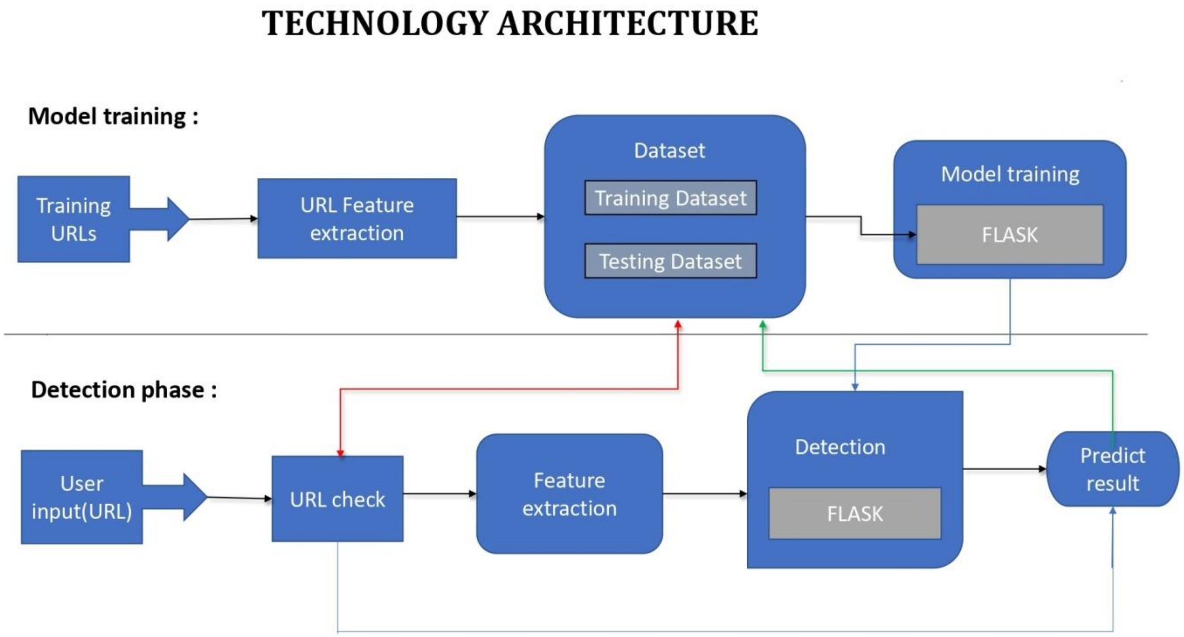
NFR-6	**Scalability**	This solution is scalable enough to fit theSecurity issues by constructing the best website. The cost of establishing the website and maintaining all the programs may be high . It is acceptable to fit them over any place and any resources.

5. PROJECT DESIGN

Data Flow Diagrams



Solution & Technical Architecture



6. PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	URL detector	USN-1	URL is the first thing to analyze a website to decide whether it is a phishing or not	10	High	Kishore R Lokesh Kanna S

Sprint-1		USN-2	Some of URL-Based Features are ● Digit count in the URL ● Total length of URL ● Checking whether the URL is typo-squatted or not ● Checking whether it includes a legitimate brand name or not ● Number of subdomains in URL ● TLD is one of the commonly used one	10	High	Kishore R Lokesh Kanna S
Sprint-2	Domain detection	USN-3	The purpose of Phishing Domain Detection is detecting phishing domain names. Therefore, passive queries related to the domain name, which we want to classify as phishing or not, provide useful information to us.	10	High	Jaiganesh T S Kondaru Venkata Sai Rakesh
Sprint-2		USN-4	Some useful Domain-Based Features are ● Its domain name or its IP address in blacklists of well-known reputation services? ● How many days passed since the domain was registered? ● Is the registrant name hidden?	10	High	Jaiganesh T S Kondaru Venkata Sai Rakesh

Sprint-3	Page based features and Content based features	USN-5	Page-Based Features are using information about pages which are calculated reputation ranking services. Obtaining these types of features requires active scan to target domain. Page contents are processed for us to detect whether target domain is used for phishing or not	10	High	Kishore R Lokesh Kanna S
Sprint-3			● Global pagerank ● Country pagerank ● Position at the Alexa top 1 million site Some processed information about pages are ● Page titles ● Meta tags ● Hidden text ● Text in the body ● Images etc.			Kishore R Lokesh Kanna S
Sprint-4	Detection process	USN-6	Detecting Phishing Domains is a classification problem, so it means we need labeled data which has samples as phish domains and l egitimate domains in the training phase	20		Jaiganesh T S Kondaru Venkata Sai Rakesh

Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	10	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	10	05 Nov 2022

Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	10	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

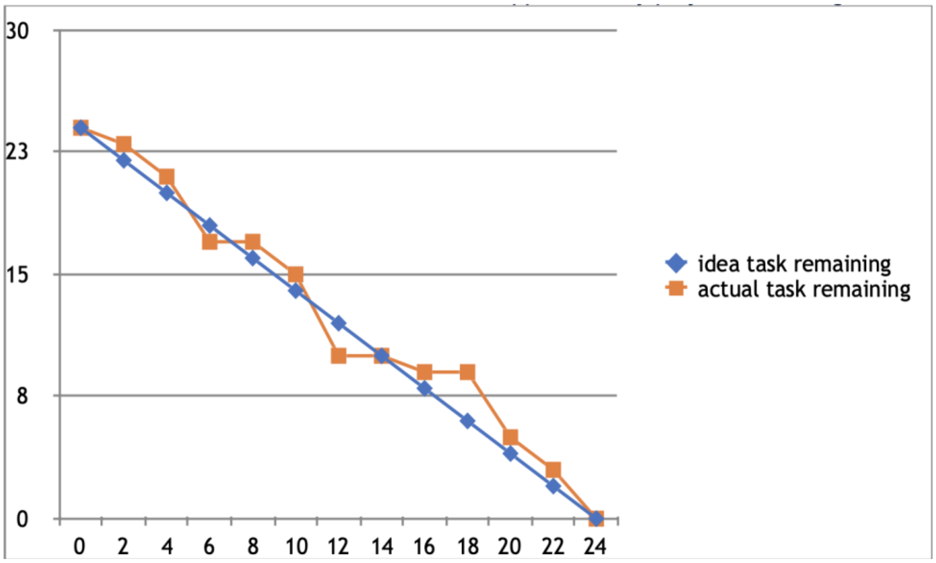
Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let’s calculate the team’s average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart:

A burndown chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

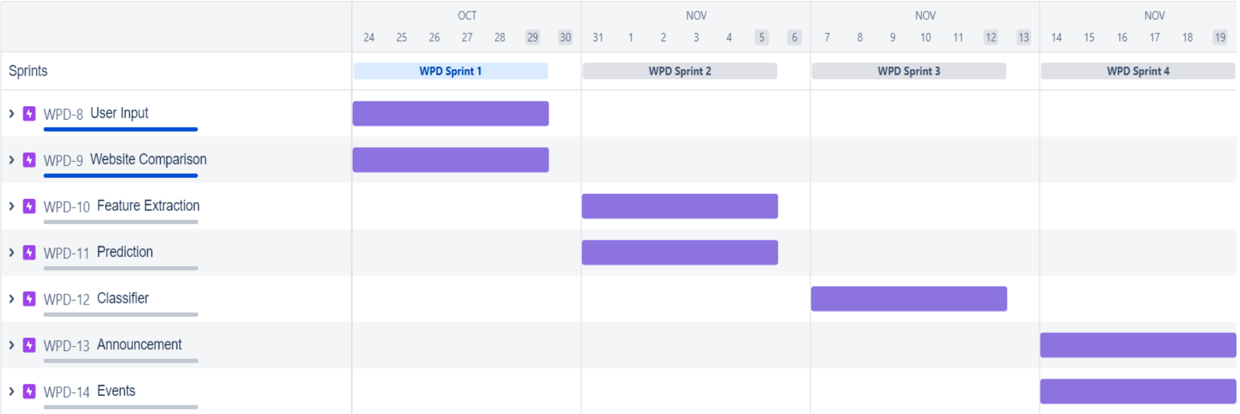


Sprint Delivery Schedule

Sprint	**Sprint Topic**	**Start Date**	**Expected Delivery**
Sprint 1	URL detector	24-10-2022	29-10-2022

Sprint 2	Domain detection	31-10-2022	05-11-2022
Sprint 3	Page based features and content based features	07-11-2022	12-11-2022
Sprint 4	Detection process	14-11-2022	19-11-2022

Reports from JIRA



7. CODING & SOLUTIONING

Feature 1

This feature is used to import required libraries to load the model from the .pkl file which was builded in the model building phase.

Coding :

```
from flask import Flask, request, render_template
import numpy as np
import pandas as pd
```

```
from sklearn import metrics
import warnings
import pickle
warnings.filterwarnings('ignore')
from feature import FeatureExtraction

file = open("model.pkl","rb")
gbc = pickle.load(file)
file.close()


app = Flask(__name__)

@app.route("/", methods=["GET", "POST"])
def index():
    if request.method == "POST":

        url =  request.form["url"]
        obj = FeatureExtraction(url)
        x = np.array(obj.getFeaturesList()).reshape(1,30)

        y_pred =gbc.predict(x)[0]
        #1 is safe
        #-1 is unsafe
        y_pro_phishing = gbc.predict_proba(x)[0,0]
        y_pro_non_phishing = gbc.predict_proba(x)[0,1]
        # if(y_pred ==1 ):
        pred = "It is {0:.2f} % safe to go ".format(y_pro_phishing*100)
                                        return render_template('index.html',xx
=round(y_pro_non_phishing,2),url=url )
    return render_template("index.html", xx =-1)


if __name_  == "_main_":
    app.run(debug=True,port=2002)
```

Feature 2

This feature helps in providing easy UI to the user using the web interface.
Coding :

```
<!DOCTYPE html>
<html lang="en">
<head>
    <center> <h1> IBM Project Based Learning </h1> </center>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta name="description" content="This website is develop for identify the safety of url.">
    <meta name="keywords" content="phishing url,phishing,cyber security,machine learning,classifier,python">
    <meta name="author" content="Balajee A V">

    <!-- BootStrap -->
    <link rel="stylesheet" href="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/css/bootstrap.min.css"
        integrity="sha384-9aIt2nRpC12Uk9gS9baDl411NQApFmC26EwAOH8WgZl5MYYxFfc+NcPb1dKGj7Sk" crossorigin="anonymous">

    <link href="static/styles.css" rel="stylesheet">
    <title>URL detection</title>
</head>

<body>
 <center> <img class="image image-contain" src="https://cdn.activestate.com/wp-content/uploads/2021/02/phishing-detection-with-Python.jpg" alt="MDN logo" /> </center>
```

```
<div class=" container">
    <div class="row">
        <div class="form col-md" id="form1">
            <h2>PHISHING URL DETECTION</h2>

            <br>
            <form action="/" method ="post">
                <input type="text" class="form_input" name ='url' id="url" placeholder="Enter URL" required="" />
                <label for="url" class="form__label">URL</label>
                <button class="button" role="button" >Check here</button>
            </form>

    </div>

    <div class="col-md" id="form2">

        <br>
        <h6 class = "right "><a href= {{ url }} target="_blank">{{ url }}</a></h6>

        <br>
        <h3 id="prediction"></h3>
        <button class="button2" id="button2" role="button" onclick="window.open('{{url}}')" target="_blank" >Still want to Continue</button>
        <button class="button1" id="button1" role="button"  onclick="window.open('{{url}}')" target="_blank">Continue</button>
    </div>
</div>
<br>
</div>

    <!-- JavaScript -->
    <script src="https://code.jquery.com/jquery-3.5.1.slim.min.js"
```

```
        integrity="sha384-DfXdz2htPH0lsSSs5nCTpuj/zy4C+OGpamoFVy38MVBnE+IbbVYUew+OrCXaRkfj"
        crossorigin="anonymous"></script>
    <script src="https://cdn.jsdelivr.net/npm/popper.js@1.16.0/dist/umd/popper.min.js"
        integrity="sha384-Q6E9RHvbIyZFJoft+2mJbHaEWldlvI9IOYy5n3zV9zzTtmI3UksdQRVvoxMfooAo"
        crossorigin="anonymous"></script>
    <script src="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/js/bootstrap.min.js"
        integrity="sha384-OgVRvuATP1z7JjHLkuOU7Xw704+h835Lr+6QL9UvYjZE3Ipu6Tp75j7Bh/kR0JKI"
        crossorigin="anonymous"></script>


    <script>

            let x = '{{xx}}';
            let num = x*100;
            if (0<=x && x<0.50){
                num = 100-num;
            }
            let txtx = num.toString();
            if(x<=1 && x>=0.50){
                var label = "Website is "+txtx +"% safe to use...";
                document.getElementById("prediction").innerHTML = label;
                document.getElementById("button1").style.display="block";
            }
            else if (0<=x && x<0.50){
                var label = "Website is "+txtx +"% unsafe to use..."
                document.getElementById("prediction").innerHTML = label ;
                document.getElementById("button2").style.display="block";
            }

    </script>
```

```
</body>
</html>
```

8. TESTING

Test Cases

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation (Y/N)	BUG ID	Executed By
LoginPage – TC_OO1	UI	Home Page	UI Verify the elements is Responsive		1. Enter URL and click go 2. Type or copy paste the URL 3. Check whether the button is responsive or not 4. Reload and Test Simultaneously	https://www.google.com/	Should Wait for Response and then gets Acknowledge	Working as expected	Pass		N		Lokesh Kanna S

LoginPage_TC_OO2	Functional	Home page	Verify whether the link is legitimate or not		1. Enter URL and click go 2. Type or copy paste the URL 3. Check the website is legitimate or not 4. Observe the results	https://www.youtube.com/	User should observe whether the website is legitimate or not.	Working as expected	Pass		N		Kondaru Venkata Sai Rakesh
LoginPage_TC_OO3	Functional	Home Page	Verify user is able to access the legitimate website or not		1. Enter URL and click go 2. Type or copy paste the URL 3. Check the website is legitimate or not 4. Continue if the website is legitimate or be cautious if it is not legitimate.	http://ssalescript.info/	Application should show that Safe Webpage or Unsafe.	Working as expected	Pass		N		Kishore R

LoginPage_TC_OO4	Functional	Home Page	Testing the website with multiple URLs		1. Enter URL (https://phishing-shield.herokuapp.com/) and click go 2. Type or copy paste the URL totest 3. Check the website is legitimate or not 4. Continue if the website is secure or be cautious if it is not secure	https://www.delgets.com/	User can able to identify the websites whether it is secure or not	Working as expected	Pass		N		Jaiganesh T S

User Acceptance Testing

1. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	10	2	4	20	36
Not Reproduced	0	0	1	0	1
Skipped	0	0	0	0	0

Won't Fix	0	0	2	1	3
Totals	23	9	12	25	60

1. **Test Case Analysis**

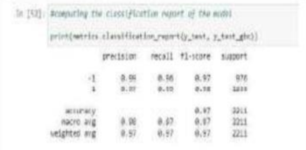
This report shows the number of test cases that have passed, failed, and untested

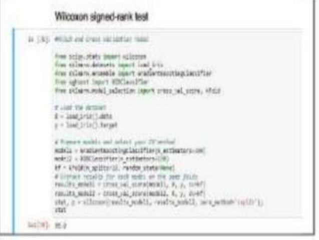
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	10	0	0	10
Client Application	50	0	0	50
Security	5	0	0	4
Outsource Shipping	3	0	0	3
Exception Reporting	10	0	0	9
Final Report Output	10	0	0	10
Version Control	4	0	0	4

9. RESULTS

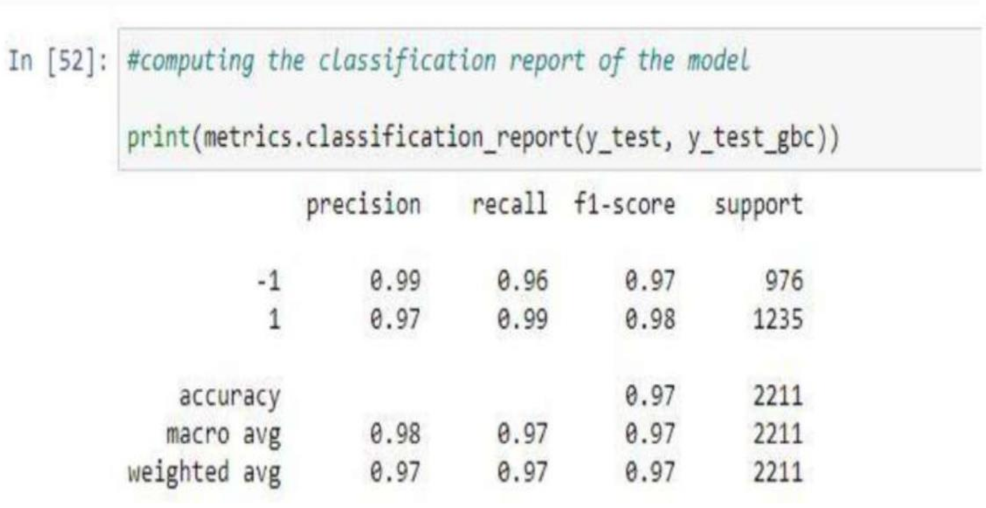
Performance Metrics

S.No.	Parameter	Values	Screenshot

1.	Metrics	**Classification Model:**
		Gradient Boosting Classification
		Accuray Score- 97.4%
			
			In [52]: #computing the classification report of the model
			print(metrics.classification_report(y_test, y_test_gbc))
			precision recall f1-score support
			-1 0.99 0.96 0.97 976
			1 0.97 0.99 0.98 1235
			accuracy 0.97 2211
			macro avg 0.98 0.97 0.97 2211
			weighted avg 0.97 0.97 0.97 2211

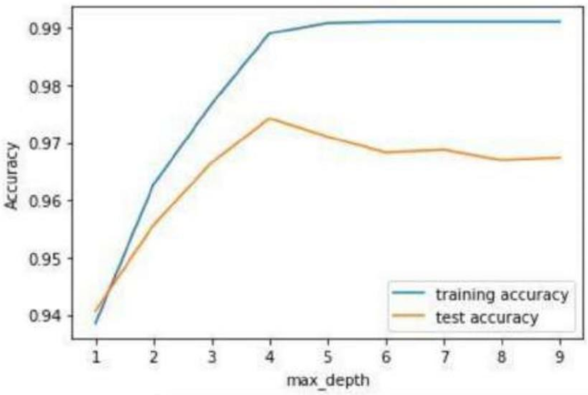
2.	Tune the Model	Hyperparameter Tuning - 97%
		Validation Method – KFOLD &
		Cross Validation Method
			
			Wilcoxon signed-rank test
			In [8]: #KFOLD and Cross Validation model
			from scipy.stats import wilcoxon
			from sklearn.datasets import load_iris
			from sklearn.ensemble import GradientBoostingClassifier
			from xgboost import XGBClassifier
			from sklearn.model_selection import cross_val_score, KFold
			# Load the dataset
			X = load_iris().data
			y = load_iris().target
			# Prepare models and select your CV method
			model1 = GradientBoostingClassifier(n_estimators=100)
			model2 = XGBClassifier(n_estimators=100)
			kf = KFold(n_splits=20, random_state=None)
			# Extract results for each model on the same folds
			results_model1 = cross_val_score(model1, X, y, cv=kf)
			results_model2 = cross_val_score(model2, X, y, cv=kf)
			stat, p = wilcoxon(results_model1, results_model2, zero_method='zsplit');
			stat
			Out[8]: 95.0

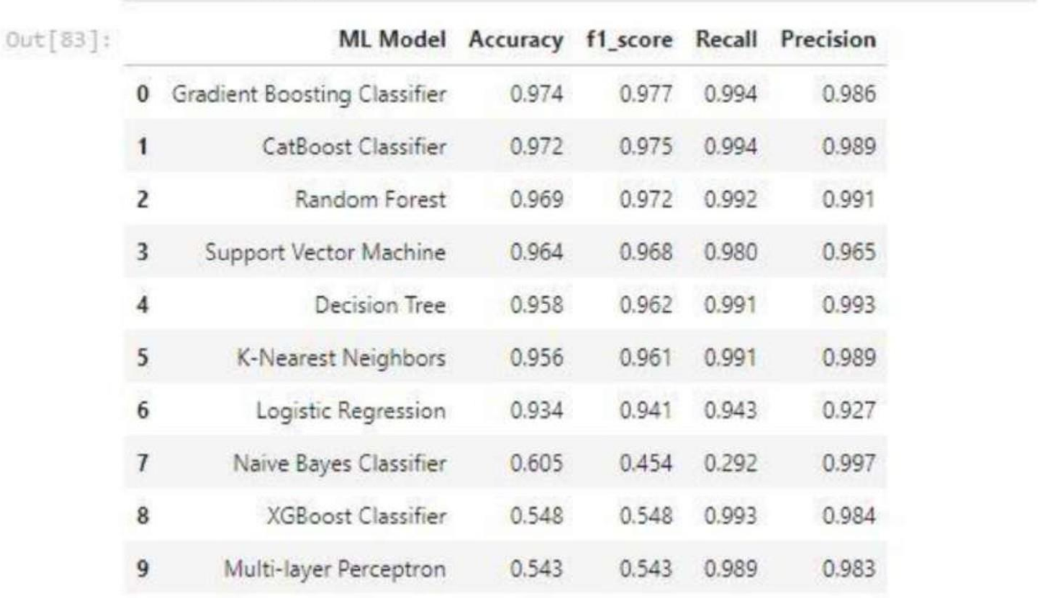
1. METRICS:
CLASSIFICATION REPORT:



```
In [52]: #computing the classification report of the model

         print(metrics.classification_report(y_test, y_test_gbc))

              precision    recall  f1-score   support

          -1       0.99      0.96      0.97       976
           1       0.97      0.99      0.98      1235

    accuracy                           0.97      2211
   macro avg       0.98      0.97      0.97      2211
weighted avg       0.97      0.97      0.97      2211
```

PERFORMANCE :

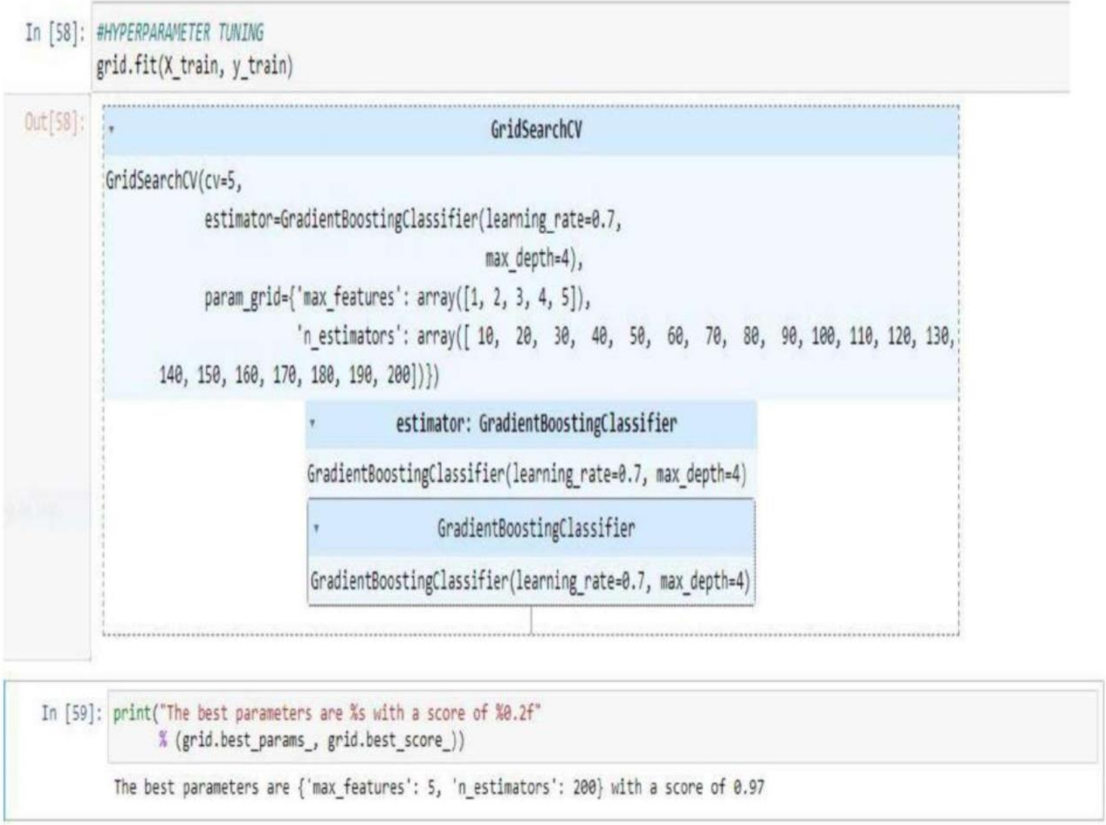




Out[83]:

	ML Model	Accuracy	f1_score	Recall	Precision
0	Gradient Boosting Classifier	0.974	0.977	0.994	0.986
1	CatBoost Classifier	0.972	0.975	0.994	0.989
2	Random Forest	0.969	0.972	0.992	0.991
3	Support Vector Machine	0.964	0.968	0.980	0.965
4	Decision Tree	0.958	0.962	0.991	0.993
5	K-Nearest Neighbors	0.956	0.961	0.991	0.989
6	Logistic Regression	0.934	0.941	0.943	0.927
7	Naive Bayes Classifier	0.605	0.454	0.292	0.997
8	XGBoost Classifier	0.548	0.548	0.993	0.984
9	Multi-layer Perceptron	0.543	0.543	0.989	0.983

2. TUNE THE MODEL – HYPERPARAMETER TUNING

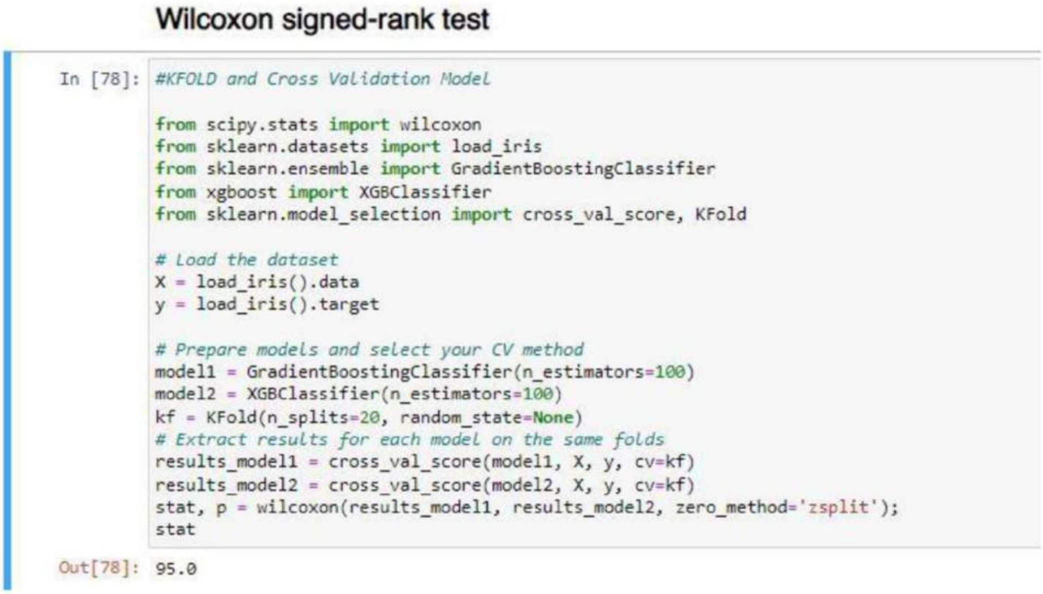


```
In [58]: #HYPERPARAMETER TUNING
         grid.fit(X_train, y_train)
```

```
Out[58]:
                                GridSearchCV
GridSearchCV(cv=5,
             estimator=GradientBoostingClassifier(learning_rate=0.7,
                                                  max_depth=4),
             param_grid={'max_features': array([1, 2, 3, 4, 5]),
                         'n_estimators': array([ 10,  20,  30,  40,  50,  60,  70,  80,  90, 100, 110, 120, 130,
       140, 150, 160, 170, 180, 190, 200])})

                 estimator: GradientBoostingClassifier
          GradientBoostingClassifier(learning_rate=0.7, max_depth=4)

                      GradientBoostingClassifier
          GradientBoostingClassifier(learning_rate=0.7, max_depth=4)
```

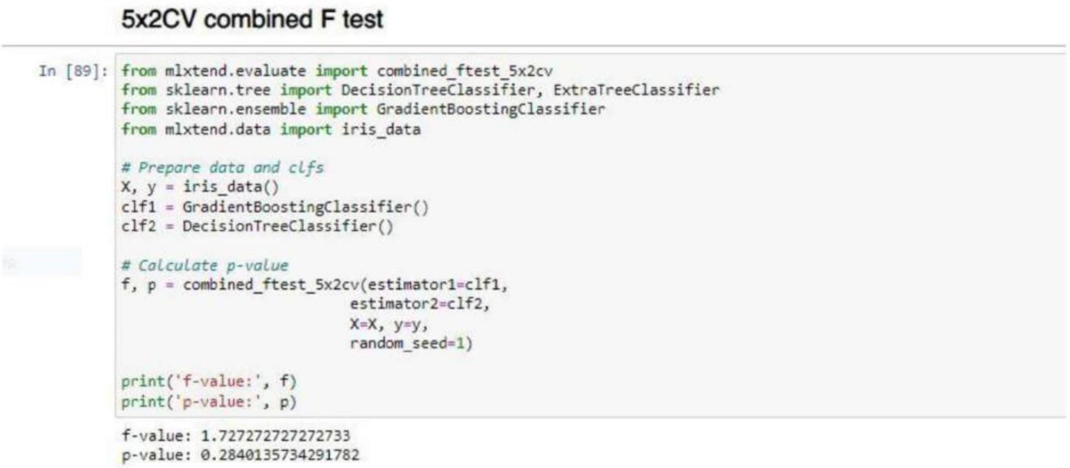
```
In [59]: print("The best parameters are %s with a score of %0.2f"
               % (grid.best_params_, grid.best_score_))

         The best parameters are {'max_features': 5, 'n_estimators': 200} with a score of 0.97
```

VALIDATION METHODS: KFOLD & Cross Folding



Wilcoxon signed-rank test

```
In [78]: #KFOLD and Cross Validation Model

         from scipy.stats import wilcoxon
         from sklearn.datasets import load_iris
         from sklearn.ensemble import GradientBoostingClassifier
         from xgboost import XGBClassifier
         from sklearn.model_selection import cross_val_score, KFold

         # Load the dataset
         X = load_iris().data
         y = load_iris().target

         # Prepare models and select your CV method
         model1 = GradientBoostingClassifier(n_estimators=100)
         model2 = XGBClassifier(n_estimators=100)
         kf = KFold(n_splits=20, random_state=None)
         # Extract results for each model on the same folds
         results_model1 = cross_val_score(model1, X, y, cv=kf)
         results_model2 = cross_val_score(model2, X, y, cv=kf)
         stat, p = wilcoxon(results_model1, results_model2, zero_method='zsplit');
         stat

Out[78]: 95.0
```



5x2CV combined F test

```
In [89]: from mlxtend.evaluate import combined_ftest_5x2cv
         from sklearn.tree import DecisionTreeClassifier, ExtraTreeClassifier
         from sklearn.ensemble import GradientBoostingClassifier
         from mlxtend.data import iris_data

         # Prepare data and clfs
         X, y = iris_data()
         clf1 = GradientBoostingClassifier()
         clf2 = DecisionTreeClassifier()

         # Calculate p-value
         f, p = combined_ftest_5x2cv(estimator1=clf1,
                                     estimator2=clf2,
                                     X=X, y=y,
                                     random_seed=1)

         print('f-value:', f)
         print('p-value:', p)

         f-value: 1.727272727272733
         p-value: 0.2840135734291782
```

10. ADVANTAGES & DISADVANTAGES

Advantages:

- This system can be used by many E-commerce or other websites in order to have good customer relationship.
- User can make online payment securely.
- Data mining algorithm used in this system provides better performance as compared to other traditional classifications algorithms.
- With the help of this system user can also purchase products online without any hesitation.

Disadvantages

- If Internet connection fails, this system won't work.
- All websites related data will be stored in one place.

11. CONCLUSION

It is outstanding that a decent enemy of phishing apparatus ought to anticipate the phishing assaults in a decent timescale. We accept that the accessibility of a decent enemy of phishing device at a decent time scale is additionally imperative to build the extent of anticipating phishing sites. This apparatus ought to be improved continually through consistent retraining. As a matter of fact, the accessibility of crisp and cutting-edge preparing dataset which may gained utilizing our very own device [30, 32] will help us to retrain our model consistently and handle any adjustments in the highlights, which are influential in deciding the site class. Albeit neural system demonstrates its capacity to tackle a wide assortment of classification issues, the procedure of finding the ideal structure is very difficult, and much of the time, this structure is controlled by experimentation.Our model takes care of this issue via computerizing the way toward organizing a neural system conspire; hence, on the off chance that we construct an enemy of phishing model and for any reasons we have to refresh it, at that point our model will encourage this procedure, that is, since our model will mechanize the organizing procedure and will request scarcely any client defined parameters.

12. FUTURE SCOPE

In future if we get structured dataset of phishing we can perform phishing detection much more faster than any other technique.In future we can use a combination of any other two or more classifier to get maximum accuracy. We also plan to explore various phishing techniques that uses Lexical features, Network based features,Content based features, Webpage based features and HTML and JavaScript features of web pages which can improve the performance of the system. In particular, we extract features from URLs and pass it through the various classifiers.

13. APPENDIX

A mechanism to detect phishing websites. Our methodology uses not just traditional URL based or content based rules but rather employs the machine learning technique to identify not so obvious patterns and relations in the data. We have used features from various domain spanning from URL to HTML tags of the webpage, from embedded URLs to favicon, and databases like WHOIS, Alexa, Pagerank, etc. to check the traffic and status of the website. We were able to obtain an accuracy of more than 96%, recall greater than 96% with a False Positive Rate of less than 5%, thus classifying most websites correctly and proving the effectiveness of the machine learning based technique to attack the problem of phishing websites. We provided the output as a user-friendly web platform which can further be extended to a browser extension to provide safe and healthy online space to the users.

Source Code:

```
import ipaddress
import re
import urllib.request
from bs4 import BeautifulSoup
import socket
import requests
from googlesearch import search
import whois
```

```
from datetime import date, datetime
import time
from dateutil.parser import parse as date_parse
from urllib.parse import urlparse

class FeatureExtraction:
    features = []
    def___init_(self,url):
        self.features = []
        self.url = url
        self.domain = ""
        self.whois_response = ""
        self.urlparse = ""
        self.response = ""
        self.soup = ""

        try:
            self.response = requests.get(url)
            self.soup = BeautifulSoup(response.text, 'html.parser')
        except:
            pass

        try:
            self.urlparse = urlparse(url)
            self.domain = self.urlparse.netloc
        except:
            pass
```

```
try:
    self.whois_response = whois.whois(self.domain)
except:
    pass
self.features.append(self.UsingIp())
self.features.append(self.longUrl())
self.features.append(self.shortUrl())
self.features.append(self.symbol())
self.features.append(self.redirecting())
self.features.append(self.prefixSuffix())
self.features.append(self.SubDomains())
self.features.append(self.Hppts())
self.features.append(self.DomainRegLen())
self.features.append(self.Favicon())
self.features.append(self.NonStdPort())
self.features.append(self.HTTPSDomainURL())
self.features.append(self.RequestURL())
self.features.append(self.AnchorURL())
self.features.append(self.LinksInScriptTags())
self.features.append(self.ServerFormHandler())
self.features.append(self.InfoEmail())
self.features.append(self.AbnormalURL())
self.features.append(self.WebsiteForwarding())
self.features.append(self.StatusBarCust())
self.features.append(self.DisableRightClick())
self.features.append(self.UsingPopupWindow())
```

```
    self.features.append(self.IframeRedirection())
    self.features.append(self.AgeofDomain())
    self.features.append(self.DNSRecording())
    self.features.append(self.WebsiteTraffic())
    self.features.append(self.PageRank())
    self.features.append(self.GoogleIndex())
    self.features.append(self.LinksPointingToPage())
    self.features.append(self.StatsReport())
 # 1.UsingIp
def UsingIp(self):
    try:
        ipaddress.ip_address(self.url)
        return -1
    except:
        return 1

# 2.longUrl
def longUrl(self):
    if len(self.url) < 54:
        return 1
    if len(self.url) >= 54 and len(self.url) <= 75:
        return 0
    return -1

# 3.shortUrl
def shortUrl(self):
```

```
                match = re.search('bit\.ly|goo\.gl|shorte\.st|go2l\.ink|x\.co|ow\.ly|t\.co|tinyurl|tr\.im|is\.gd|cli\.gs|'
                            'yfrog\.com|migre\.me|ff\.im|tiny\.cc|url4\.eu|twit\.ac|su\.pr|twurl\.nl|snipurl\.com|'
                            'short\.to|BudURL\.com|ping\.fm|post\.ly|Just\.as|bkite\.com|snipr\.com|fic\.kr|loopt\.us|'
                            'doiop\.com|short\.ie|kl\.am|wp\.me|rubyurl\.com|om\.ly|to\.ly|bit\.do|t\.co|lnkd\.in|'
                            'db\.tt|qr\.ae|adf\.ly|goo\.gl|bitly\.com|cur\.lv|tinyurl\.com|ow\.ly|bit\.ly|ity\.im|'
                            'q\.gs|is\.gd|po\.st|bc\.vc|twitthis\.com|u\.to|j\.mp|buzurl\.com|cutt\.us|u\.bb|yourls\.org|'
                            'x\.co|prettylinkpro\.com|scrnch\.me|filoops\.info|vzturl\.com|qr\.net|1url\.com|tweez\.me|v\.gd|tr\.im|link\.zip\.net', self.url)
        if match:
            return -1
        return 1

    # 4.Symbol@
    def symbol(self):
        if re.findall("@",self.url):
            return -1
        return 1

    #  5.Redirecting//
    def redirecting(self):
        if self.url.rfind('//')>6:
```

```
        return -1
    return 1

# 6.prefixSuffix
def prefixSuffix(self):
    try:
        match = re.findall('\-', self.domain)
        if match:
            return -1
        return 1
    except:
        return -1

# 7.SubDomains
def SubDomains(self):
    dot_count = len(re.findall("\.", self.url))
    if dot_count == 1:
        return 1
    elif dot_count == 2:
        return 0
    return -1

# 8.HTTPS
def Hppts(self):
    try:
        https = self.urlparse.scheme
        if 'https' in https:
            return 1
        return -1
    except:
        return 1

# 9.DomainRegLen
def DomainRegLen(self):
    try:
        expiration_date = self.whois_response.expiration_date
        creation_date = self.whois_response.creation_date
        try:
            if(len(expiration_date)):
                expiration_date = expiration_date[0]
        except:
            pass
        try:
            if(len(creation_date)):
                creation_date = creation_date[0]
        except:
            pass

                age = (expiration_date.year-creation_date.year)*12+ (expiration_date.month-creation_date.month)
        if age >=12:
            return 1
        return -1
    except:
        return -1

# 10. Favicon
def Favicon(self):
    try:
        for head in self.soup.find_all('head'):
            for head.link in self.soup.find_all('link', href=True):
                dots = [x.start(0) for x in re.finditer('\.', head.link['href'])]
                  if self.url in head.link['href'] or len(dots) == 1 or domain in head.link['href']:
                    return 1
        return -1
    except:
        return -1

# 11. NonStdPort
def NonStdPort(self):
    try:
        port = self.domain.split(":")
        if len(port)>1:
            return -1
        return 1
    except:
        return -1

# 12. HTTPSDomainURL
def HTTPSDomainURL(self):
    try:
        if 'https' in self.domain:
            return -1
        return 1
    except:
        return -1

# 13. RequestURL
def RequestURL(self):
    try:
        for img in self.soup.find_all('img', src=True):
            dots = [x.start(0) for x in re.finditer('\.', img['src'])]
            if self.url in img['src'] or self.domain in img['src'] or len(dots) == 1:
                success = success + 1
            i = i+1

        for audio in self.soup.find_all('audio', src=True):
            dots = [x.start(0) for x in re.finditer('\.', audio['src'])]
             if self.url in audio['src'] or self.domain in audio['src'] or len(dots) ==
1:
                success = success + 1
            i = i+1

        for embed in self.soup.find_all('embed', src=True):
            dots = [x.start(0) for x in re.finditer('\.', embed['src'])]
              if self.url in embed['src'] or self.domain in embed['src'] or len(dots)
== 1:
```

```
                    success = success + 1
                i = i+1

            for iframe in self.soup.find_all('iframe', src=True):
                dots = [x.start(0) for x in re.finditer('\.', iframe['src'])]
                    if self.url in iframe['src'] or self.domain in iframe['src'] or len(dots)
== 1:
                    success = success + 1
                i = i+1

            try:
                percentage = success/float(i) * 100
                if percentage < 22.0:
                    return 1
                elif((percentage >= 22.0) and (percentage < 61.0)):
                    return 0
                else:
                    return -1
            except:
                return 0
        except:
            return -1

    # 14. AnchorURL
    def AnchorURL(self):
        try:
            i,unsafe = 0,0
            for a in self.soup.find_all('a', href=True):
                if "#" in a['href'] or "javascript" in a['href'].lower() or "mailto" in a['href'].lower() or not (url in a['href'] or self.domain in a['href']):
                    unsafe = unsafe + 1
                i = i + 1

            try:
                percentage = unsafe / float(i) * 100
                if percentage < 31.0:
                    return 1
                elif ((percentage >= 31.0) and (percentage < 67.0)):
                    return 0
                else:
                    return -1
            except:
                return -1

        except:
            return -1

    # 15. LinksInScriptTags
    def LinksInScriptTags(self):
        try:
            i,success = 0,0

            for link in self.soup.find_all('link', href=True):
                dots = [x.start(0) for x in re.finditer('\.', link['href'])]
```

```
                   if self.url in link['href'] or self.domain in link['href'] or len(dots) ==
1:
                    success = success + 1
                i = i+1

            for script in self.soup.find_all('script', src=True):
                dots = [x.start(0) for x in re.finditer('\.', script['src'])]
                 if self.url in script['src'] or self.domain in script['src'] or len(dots) ==
1:
                    success = success + 1
                i = i+1

            try:
                percentage = success / float(i) * 100
                if percentage < 17.0:
                    return 1
                elif((percentage >= 17.0) and (percentage < 81.0)):
                    return 0
                else:
                    return -1
            except:
                return 0
        except:
            return -1

    # 16. ServerFormHandler
    def ServerFormHandler(self):
        try:
            if len(self.soup.find_all('form', action=True))==0:
                return 1
            else :
                for form in self.soup.find_all('form', action=True):
                    if form['action'] == "" or form['action'] == "about:blank":
                        return -1
                        elif self.url not in form['action'] and self.domain not in form['action']:
                        return 0
                    else:
                        return 1
        except:
            return -1

    # 17. InfoEmail
    def InfoEmail(self):
        try:
            if re.findall(r"[mail\(\)|mailto:?]", self.soap):
                return -1
            else:
                return 1
        except:
            return -1

    # 18. AbnormalURL
    def AbnormalURL(self):
```

```
    try:
        if self.response.text == self.whois_response:
            return 1
        else:
            return -1
    except:
        return -1

# 19. WebsiteForwarding
def WebsiteForwarding(self):
    try:
        if len(self.response.history) <= 1:
            return 1
        elif len(self.response.history) <= 4:
            return 0
        else:
            return -1
    except:
         return -1

# 20. StatusBarCust
def StatusBarCust(self):
    try:
        if re.findall("<script>.+onmouseover.+</script>", self.response.text):
            return 1
        else:
            return -1
    except:
         return -1

# 21. DisableRightClick
def DisableRightClick(self):
    try:
        if re.findall(r"event.button ?== ?2", self.response.text):
            return 1
        else:
            return -1
    except:
         return -1

# 22. UsingPopupWindow
def UsingPopupWindow(self):
    try:
        if re.findall(r"alert\(", self.response.text):
            return 1
        else:
            return -1
    except:
         return -1

# 23. IframeRedirection
def IframeRedirection(self):
    try:
        if re.findall(r"[<iframe>|<frameBorder>]", self.response.text):
            return 1
        else:
            return -1
    except:
         return -1

# 24. AgeofDomain
def AgeofDomain(self):
    try:
        creation_date = self.whois_response.creation_date
        try:
            if(len(creation_date)):
                creation_date = creation_date[0]
        except:
            pass

        today  = date.today()
                age = (today.year-creation_date.year)*12+(today.month-creation_date.month)
        if age >=6:
            return 1
        return -1
    except:
        return -1

# 25. DNSRecording
def DNSRecording(self):
    try:
        creation_date = self.whois_response.creation_date
        try:
            if(len(creation_date)):
                creation_date = creation_date[0]
        except:
            pass

        today  = date.today()
                age = (today.year-creation_date.year)*12+(today.month-creation_date.month)
        if age >=6:
            return 1
        return -1
    except:
        return -1

# 26. WebsiteTraffic
def WebsiteTraffic(self):
    try:
               rank = BeautifulSoup(urllib.request.urlopen("http://data.alexa.com/data?cli=10&dat=s&url=" + url).read(), "xml").find("REACH")['RANK']
        if (int(rank) < 100000):
            return 1
        return 0
    except :
        return -1
# 27. PageRank
def PageRank(self):
    try:
               prank_checker_response = requests.post("https://www.checkpagerank.net/index.php", {"name": self.domain})

               global_rank = int(re.findall(r"Global Rank: ([0-9]+)", rank_checker_response.text)[0])
        if global_rank > 0 and global_rank < 100000:
            return 1
        return -1
    except:
        return -1

# 28. GoogleIndex
def GoogleIndex(self):
    try:
        site = search(self.url, 5)
        if site:
            return 1
        else:
            return -1
    except:
        return 1

# 29. LinksPointingToPage
def LinksPointingToPage(self):
    try:
        number_of_links = len(re.findall(r"<a href=", self.response.text))
        if number_of_links == 0:
            return 1
        elif number_of_links <= 2:
            return 0
        else:
            return -1
    except:
        return -1
# 30. StatsReport
def StatsReport(self):
    try:
        url_match = re.search(
                        'at\.ua|usa\.cc|baltazarpresentes\.com\.br|pe\.hu|esy\.es|hol\.es|
sweddy\.com|myjino\.ru|96\.lt|ow\.ly', url)
        ip_address = socket.gethostbyname(self.domain)
                        ip_match = re.search('146\.112\.61\.108|213\.174\.157\.151|
121\.50\.168\.88|192\.185\.217\.116|78\.46\.211\.158|181\.174\.165\.13|
46\.242\.145\.103|121\.50\.168\.40|83\.125\.22\.219|46\.242\.145\.98|'
                                '107\.151\.148\.44|107\.151\.148\.107|64\.70\.19\.203|
199\.184\.144\.27|107\.151\.148\.108|107\.151\.148\.109|119\.28\.52\.61|
54\.83\.43\.69|52\.69\.166\.231|216\.58\.192\.225|'
                                    '118\.184\.25\.86|67\.208\.74\.71|23\.253\.126\.58|
104\.239\.157\.210|175\.126\.123\.219|141\.8\.224\.221|10\.10\.10\.10|
43\.229\.108\.32|103\.232\.215\.140|69\.172\.201\.153|'
```

```
                                    '216\.218\.185\.162|54\.225\.104\.146|103\.243\.24\.98|
199\.59\.243\.120|31\.170\.160\.61|213\.19\.128\.77|62\.113\.226\.131|
208\.100\.26\.234|195\.16\.127\.102|195\.16\.127\.157|'
                                      '34\.196\.13\.28|103\.224\.212\.222|172\.217\.4\.225|
54\.72\.9\.51|192\.64\.147\.141|198\.200\.56\.183|23\.253\.164\.103|
52\.48\.191\.26|52\.214\.197\.72|87\.98\.255\.18|209\.99\.17\.27|'
                                        '216\.38\.62\.18|104\.130\.124\.96|47\.89\.58\.141|
78\.46\.211\.158|54\.86\.225\.156|54\.82\.156\.19|37\.157\.192\.102|
204\.11\.56\.48|110\.34\.231\.42', ip_address)
            if url_match:
                return -1
            elif ip_match:
                return -1
            return 1
        except:
            return 1

    def getFeaturesList(self):
        return self.features
```

GitHub link

https://github.com/IBM-EPBL/IBM-Project-31702-1660204377

Project demo link

https://drive.google.com/file/d/17ypJrN8QvVKPOTkpQdb6VYVBr-Clj3I79/view?usp=share_link