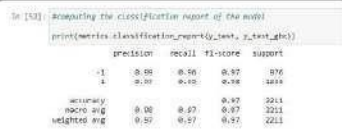



## Project Development Phase Model Performance Test

|               |                                  |
|---------------|----------------------------------|
| Date          | 19 September 2022                |
| Team ID       | PNT2022TMID34937                 |
| Project Name  | Project – Web Phishing Detection |
| Maximum Marks | 10 Marks                         |

Project team shall fill the following information in model performance testing template.

| S.No. | Parameter      | Values   | Screenshot  |
|-------|----------------|--|---|
| 1.    | Metrics        | <b>Classification Model:</b><br><b>Gradient Boosting Classification</b><br>Accuracy Score- 97.4% |  |
| 2.    | Tune the Model | Hyperparameter Tuning - 97%<br>Validation Method – KFOLD &<br>Cross Validation Method            |  |

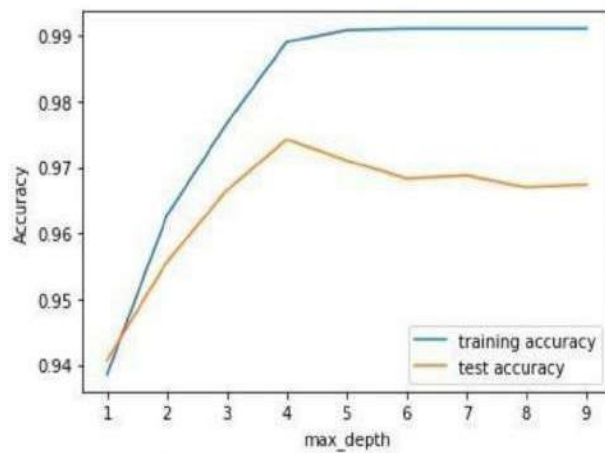
### 1. METRICS: CLASSIFICATION REPORT:

```
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 %.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