Email Classifier Project Report

The object of this project is to create a rudimentary spam email classifier using Python. For this purpose, we have utilized the following models from sklearn library:

- Multi-Layer Perceptron
- Gaussian Naive Bayes
- Decision Tree Classifier

Data

The dataset used for this analysis was sourced from Kaggle. It consisted of email data, with one column containing the text of the email and the other denoting whether it was categorized as spam or not. The dataset had already undergone preprocessing, including the removal of extraneous elements and handling of missing values. The data was split into training and test sets using a ratio of 80:20.

Model Performance

In evaluating the performance of various spam filter algorithms, we considered several metrics including accuracy, precision, recall, and F1-score. The classifiers employed were Multi-Layer Perceptron (MLP) with different architectures, Gaussian Naive Bayes, and Decision Tree Classifier.

Multi-Layer Perceptron

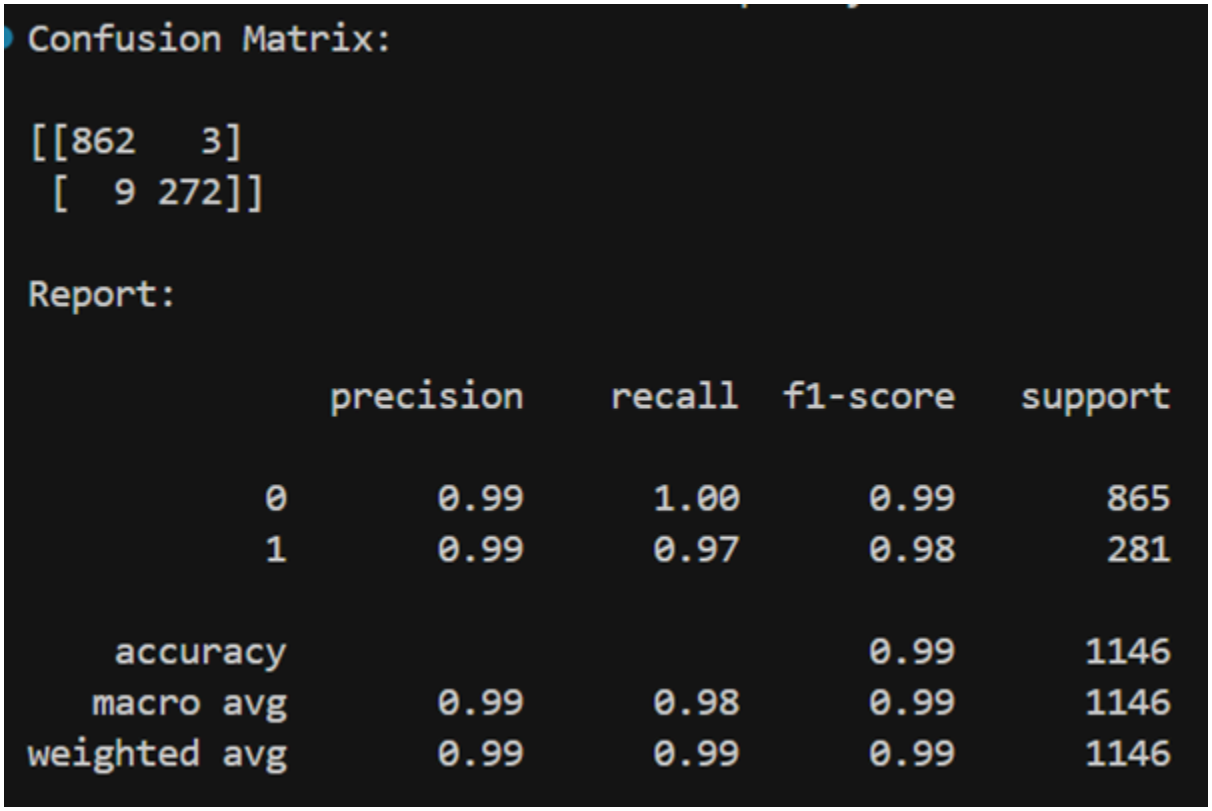
Configuration 1

The MLP Classifier with a configuration of 3 layers, each comprising 10 neurons, exhibited exceptional performance. It achieved an accuracy of 99%, with equally impressive precision, recall, and F1-score metrics all around 99%. This model demonstrated robustness in correctly classifying both spam and non-spam emails, as evidenced by the high values across all metrics.

```
Confusion Matrix:

[[836   5]
 [  8 297]]

Report:

              precision    recall  f1-score   support

           0       0.99      0.99      0.99       841
           1       0.98      0.97      0.98       305

    accuracy                           0.99      1146
   macro avg       0.99      0.98      0.99      1146
weighted avg       0.99      0.99      0.99      1146
```

Configuration 2

Comparatively, the MLP Classifier with a single layer and 10 neurons also performed admirably, achieving an accuracy of 99% with consistent precision, recall, and F1-score scores around 99%. While slightly lower than the three-layer configuration, this model still showcased strong spam classification capabilities.



```
Confusion Matrix:

[[862   3]
 [  9 272]]

Report:

              precision    recall  f1-score   support

           0       0.99      1.00      0.99       865
           1       0.99      0.97      0.98       281

    accuracy                           0.99      1146
   macro avg       0.99      0.98      0.99      1146
weighted avg       0.99      0.99      0.99      1146
```

Configuration 3

Another variant of the MLP Classifier with a single layer and fewer neurons (5 neurons) also yielded promising results, with an accuracy of 99% and equally high precision, recall, and F1-score metrics around 99%. This suggests that even a simpler neural network architecture can effectively discern spam emails from legitimate ones.

```
Confusion Matrix:

[[851   7]
 [  2 286]]


Report:

              precision    recall  f1-score   support

           0       1.00      0.99      0.99       858
           1       0.98      0.99      0.98       288

    accuracy                           0.99      1146
   macro avg       0.99      0.99      0.99      1146
weighted avg       0.99      0.99      0.99      1146
```

In contrast, both the Gaussian Naive Bayes and Decision Tree Classifier, while still performing reasonably well, fell slightly short compared to the MLP models.

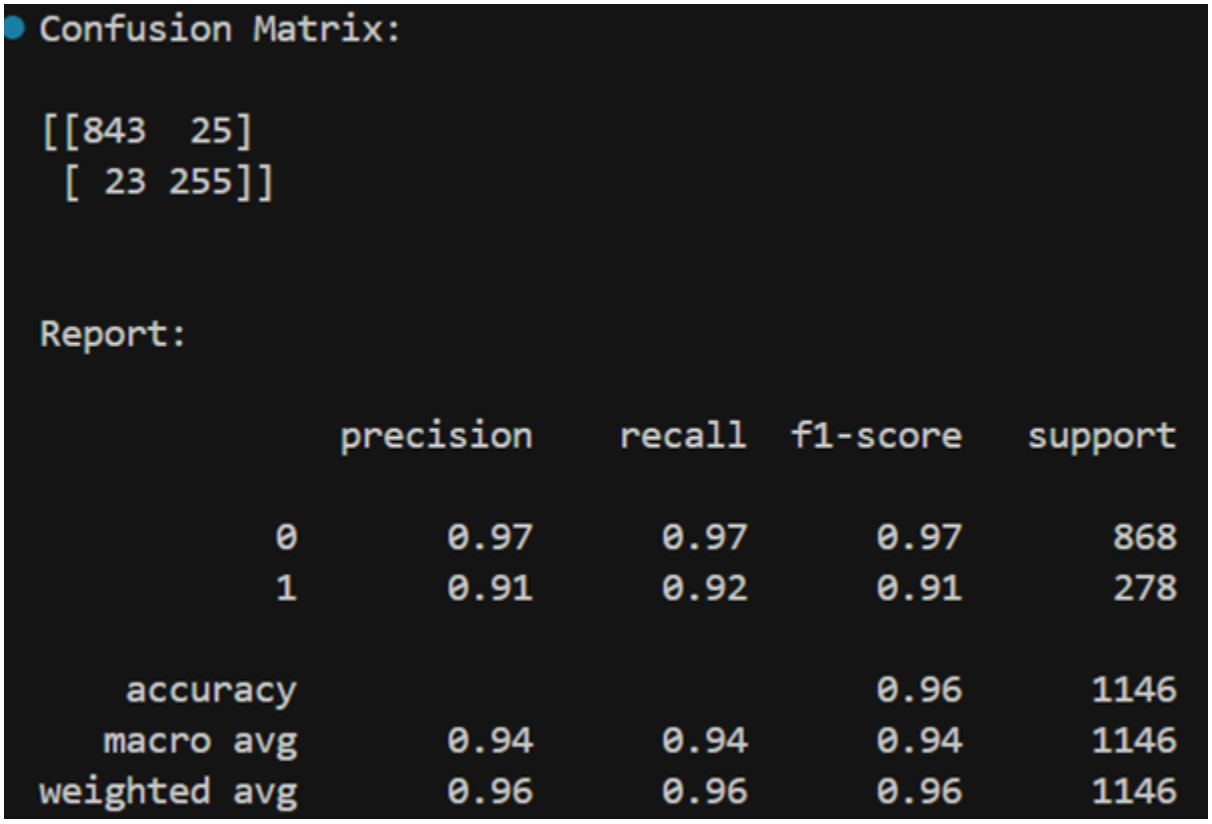
Gaussian Naive Bayes

The Gaussian Naive Bayes classifier achieved an accuracy of 96%, with precision, recall, and F1-score metrics around 95% and 94%, respectively.

```
Confusion Matrix:

[[858  12]
 [ 36 240]]


Report:

              precision    recall  f1-score   support

           0       0.96      0.99      0.97       870
           1       0.95      0.87      0.91       276

    accuracy                           0.96      1146
   macro avg       0.96      0.93      0.94      1146
weighted avg       0.96      0.96      0.96      1146
```

Decision Tree Classifier

Similarly, the Decision Tree Classifier exhibited an accuracy of 96% with precision, recall, and F1-score metrics hovering around 94% and 95%.



```
Confusion Matrix:

[[843  25]
 [ 23 255]]


Report:

              precision    recall  f1-score   support

           0       0.97      0.97      0.97       868
           1       0.91      0.92      0.91       278

    accuracy                           0.96      1146
   macro avg       0.94      0.94      0.94      1146
weighted avg       0.96      0.96      0.96      1146
```

Conclusion

Overall, the MLP classifiers, particularly the three-layer configuration, emerged as the top performers in this spam filtering task, demonstrating superior ability in accurately identifying spam emails while minimizing misclassifications.