

Result Analysis

We applied the 4 algorithms of machine learning above on our dataset to evaluate the performance, a set of evaluation metrics consisting of Accuracy, Precision, Recall, F1-Score, Confusion Matrix and ROC - AUC is used to evaluate each algorithm. The obtained results for each algorithm is documented in the corresponding tables for each algorithm below:

CNN

For the CNN model,

- The classification report of Precision, Recall, and F-1 Score against each class are stated below:

Table-1: Classification report for CNN

| Sl. No | Class | Precision | Recall | F-1 Score |
|--------|-----------------------------------|-----------|--------|-----------|
| 1 | <i>Alternanthera philoxeroide</i> | 90.91 | 71.43 | 80.00 |
| 2 | <i>Centella asiatica</i> | 93.65 | 71.95 | 81.38 |
| 3 | <i>Commelina benghalensis</i> | 77.89 | 93.67 | 85.05 |
| 4 | <i>Cyperus ochraceus</i> | 76.47 | 81.25 | 78.79 |
| 5 | <i>Fimbristylis littoralis</i> | 89.47 | 97.14 | 93.15 |
| 6 | <i>Ipomoea aquatic</i> | 98.26 | 96.57 | 97.41 |
| 7 | <i>Marsilea minuta</i> | 76.60 | 86.75 | 81.36 |
| 8 | <i>Panicum repens</i> | 86.11 | 89.86 | 87.94 |
| 9 | <i>Paspalum scrobiculatum</i> | 76.24 | 82.80 | 79.38 |
| 10 | <i>Pteris vittata</i> | 91.35 | 92.23 | 91.79 |
| 11 | <i>Synedrella nodiflora</i> | 91.35 | 92.23 | 91.79 |

- Obtained accuracy of CNN model is 87%
- Confusion matrix is stated below:

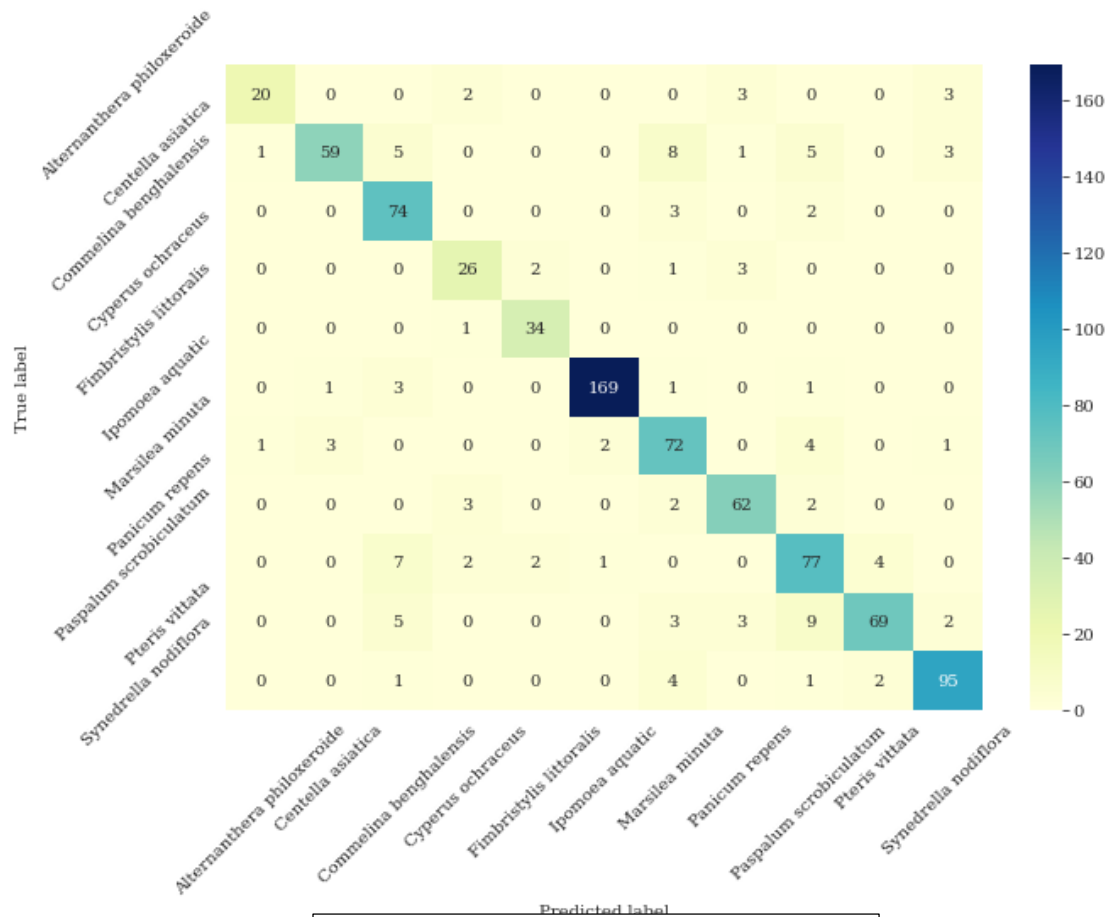


Figure-1: Confusion Matrix for CNN

- ROC AUC score is 0.9205 and the corresponding curve is:

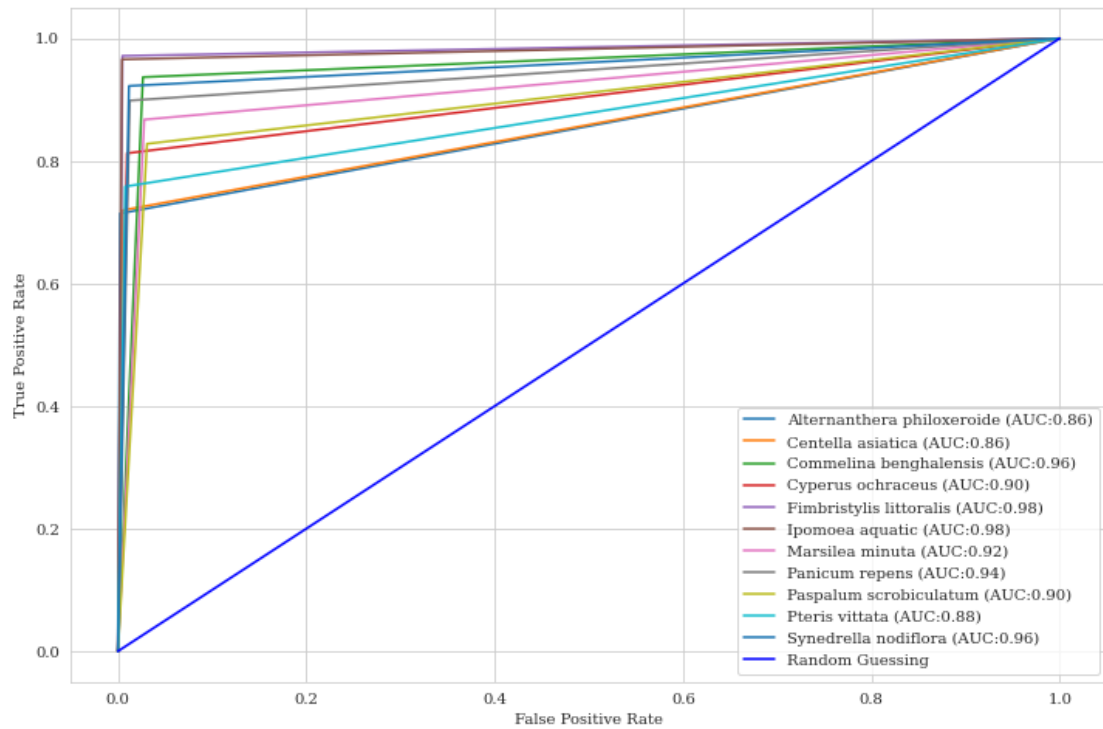
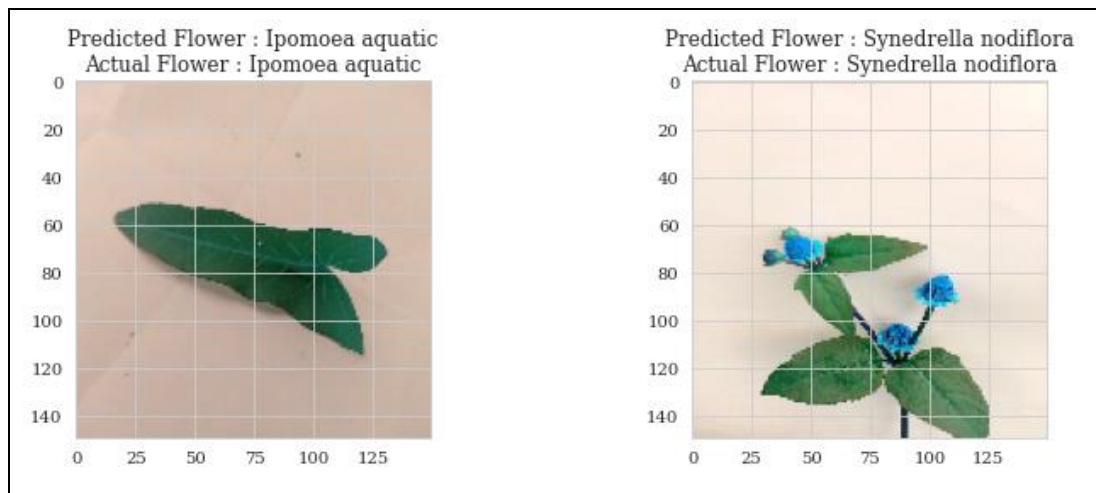


Figure-1: ROC AUC curve for CNN

Now the model can predict the weeds. Some predictions are stated below where some images are predicted accurately and some are not:



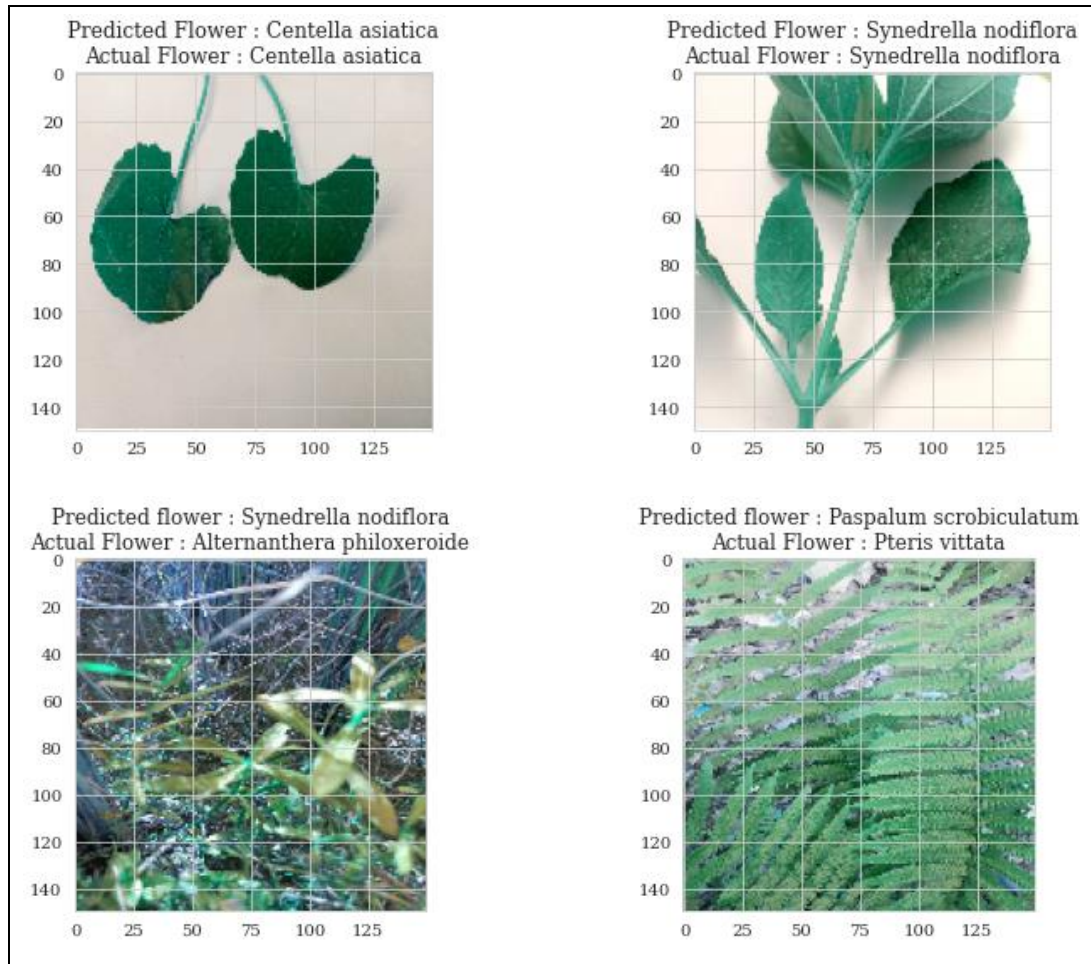


Figure-1: Some prediction of CNN model

VGG16

For the VGG16 model,

- The classification report of Precision, Recall, and F-1 Score against each class are stated below:

Table-1: Classification report for VGG16

| Sl. No | Class | Precision | Recall | F-1 Score |
|--------|------------------------------------|-----------|--------|-----------|
| 1 | <i>Alternanthera philoxeroides</i> | 95.65 | 78.75 | 86.27 |
| 2 | <i>Centella asiatica</i> | 93.02 | 97.56 | 95.24 |
| 3 | <i>Commelina benghalensis</i> | 95.12 | 98.73 | 96.89 |
| 4 | <i>Cyperus ochraceus</i> | 84.21 | 100.00 | 91.43 |
| 5 | <i>Fimbristylis littoralis</i> | 83.33 | 85.71 | 84.51 |

| | | | | |
|----|-------------------------------|--------|-------|-------|
| 6 | <i>Ipomoea aquatic</i> | 100.00 | 98.86 | 99.43 |
| 7 | <i>Marsilea minuta</i> | 98.73 | 93.98 | 96.30 |
| 8 | <i>Panicum repens</i> | 91.43 | 92.75 | 92.09 |
| 9 | <i>Paspalum scrobiculatum</i> | 95.79 | 97.85 | 96.81 |
| 10 | <i>Pteris vittata</i> | 98.90 | 98.90 | 98.90 |
| 11 | <i>Synedrella nodiflora</i> | 97.94 | 92.23 | 95.00 |

- Obtained accuracy of VGG16 model is 96%
- Confusion matrix for VGG16 is stated below:

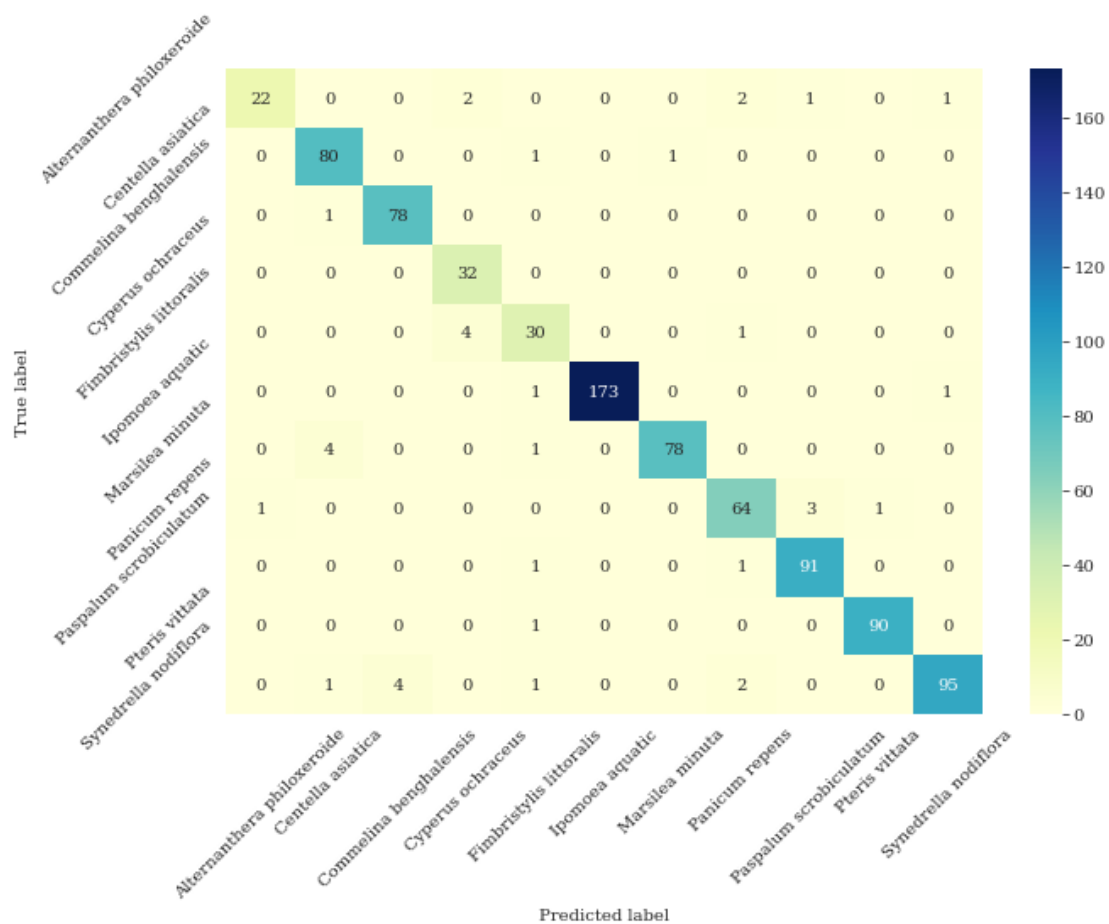


Figure-1: Confusion Matrix for CNN

- ROC AUC score of VGG16 is 0.9684 and the corresponding curve is:

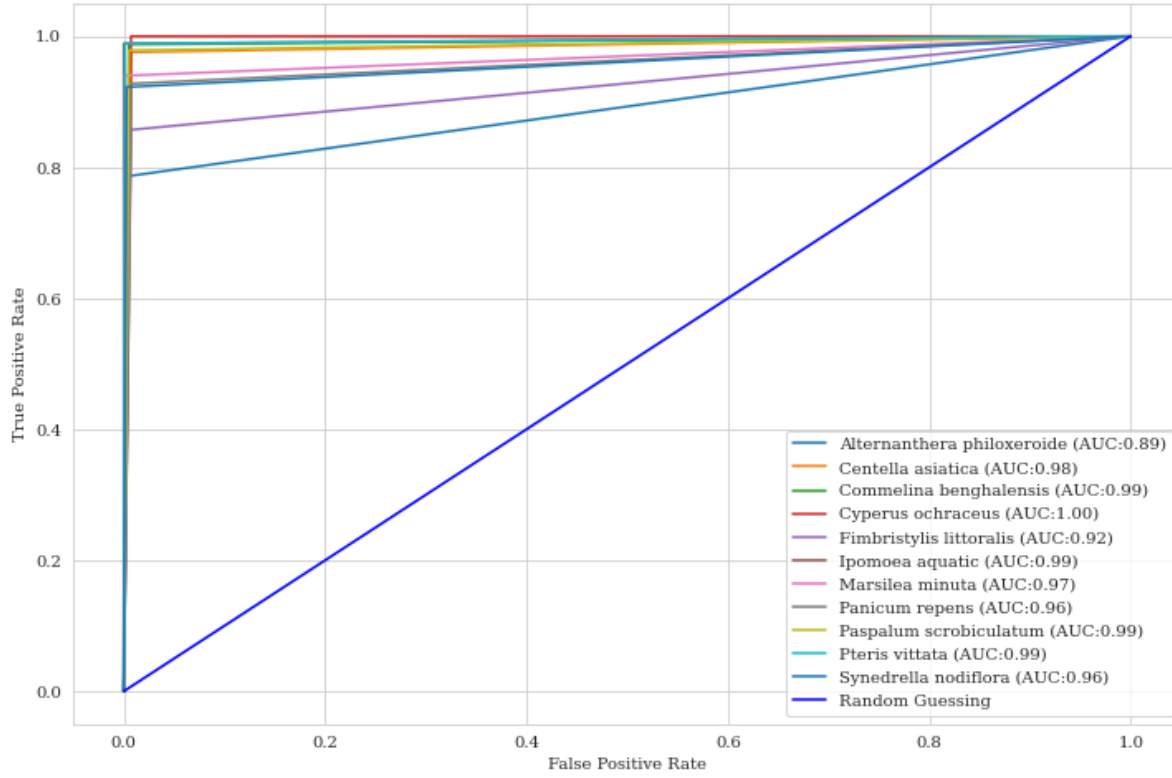


Figure-1: ROC AUC curve for VGG16

Figure-1: Some prediction of VGG16 model

Inception V3

For the Inception V3 model,

- The classification report of Precision, Recall, and F-1 Score against each class are stated below:

Table-1: Classification report of Inception V3

| Sl. No | Class | Precision | Recall | F-1 Score |
|--------|-----------------------------------|-----------|--------|-----------|
| 1 | <i>Alternanthera philoxeroide</i> | 95.45 | 75.00 | 84.00 |
| 2 | <i>Centella asiatica</i> | 93.98 | 95.12 | 94.55 |
| 3 | <i>Commelina benghalensis</i> | 96.25 | 97.47 | 96.86 |

| | | | | |
|----|--------------------------------|--------|-------|-------|
| 4 | <i>Cyperus ochraceus</i> | 87.88 | 90.62 | 89.23 |
| 5 | <i>Fimbristylis littoralis</i> | 97.06 | 94.29 | 95.65 |
| 6 | <i>Ipomoea aquatic</i> | 96.61 | 97.71 | 97.16 |
| 7 | <i>Marsilea minuta</i> | 90.00 | 86.75 | 88.34 |
| 8 | <i>Panicum repens</i> | 79.01 | 92.75 | 85.33 |
| 9 | <i>Paspalum scrobiculatum</i> | 94.74 | 96.77 | 95.74 |
| 10 | <i>Pteris vittata</i> | 100.00 | 93.41 | 96.59 |
| 11 | <i>Synedrella nodiflora</i> | 88.00 | 85.44 | 86.70 |

- Obtained accuracy of Inception V3 model is 93%
- Confusion matrix for Inception V3 is stated below:

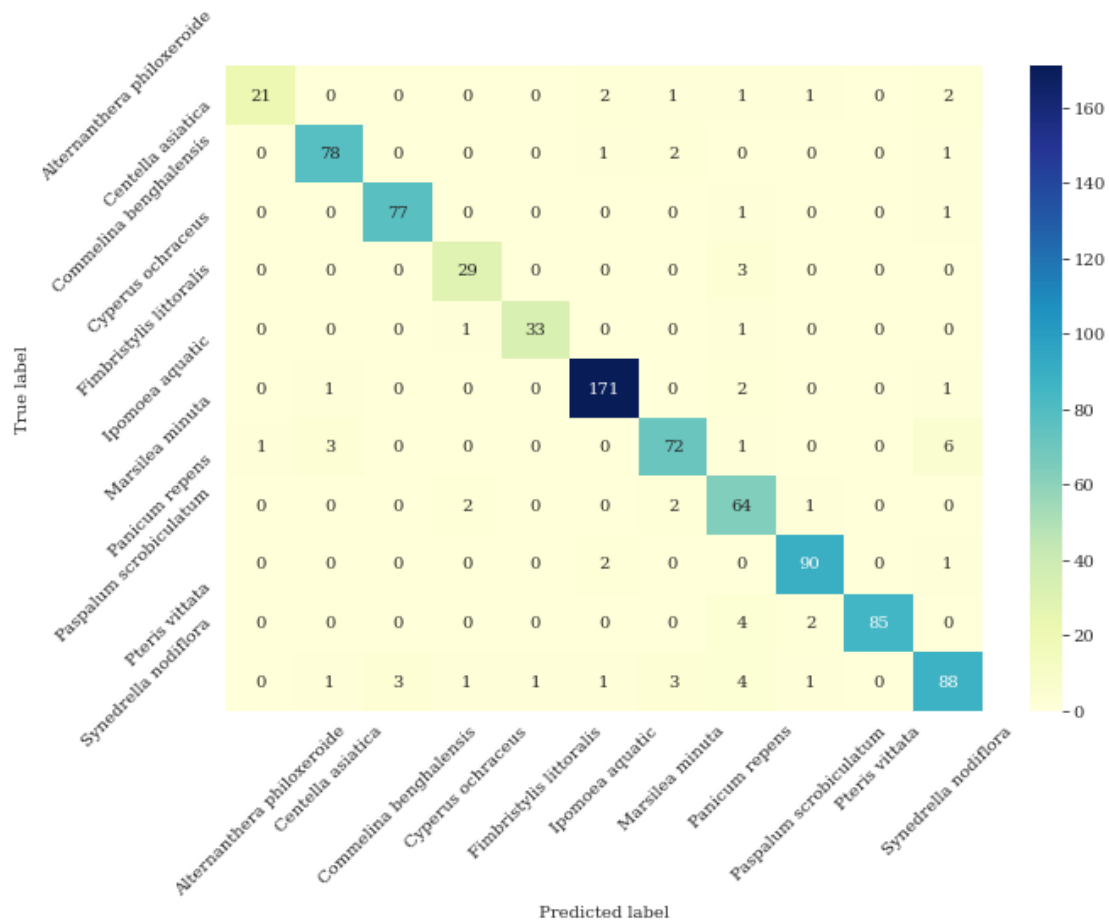


Figure-1: Confusion Matrix for Inception V3

- ROC AUC score of Inception V3 is 0.9533 and the corresponding curve is:

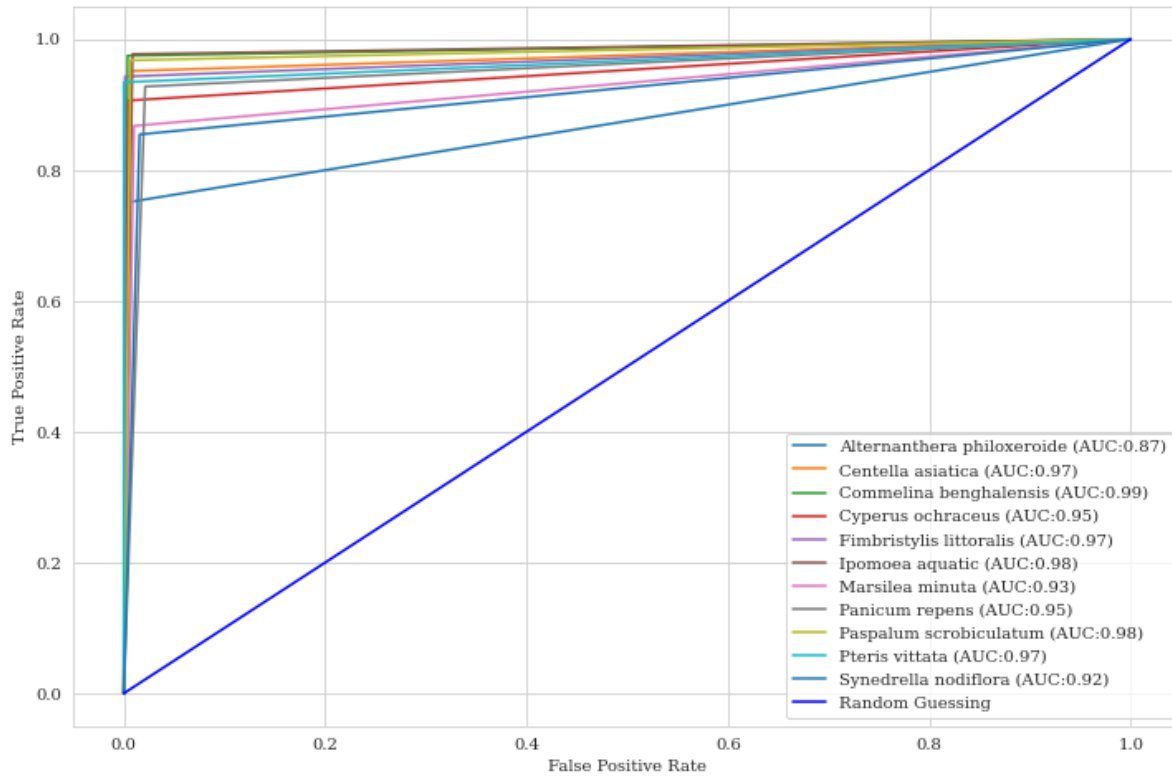


Figure-1: ROC AUC curve for Inception V3

Figure-1: Some prediction of Inception V3 model

DenseNet

For the DenseNet model,

- The classification report of Precision, Recall, and F-1 Score against each class are stated below:

Table-1: Classification report for DenseNet

| Sl. No | Class | Precision | Recall | F-1 Score |
|--------|------------------------------------|-----------|--------|-----------|
| 1 | <i>Alternanthera philoxeroides</i> | 100.00 | 85.71 | 92.31 |
| 2 | <i>Centella asiatica</i> | 98.78 | 98.78 | 98.78 |
| 3 | <i>Commelina benghalensis</i> | 97.53 | 100.00 | 98.75 |
| 4 | <i>Cyperus ochraceus</i> | 100.00 | 84.38 | 91.53 |
| 5 | <i>Fimbristylis littoralis</i> | 97.22 | 100.00 | 98.59 |
| 6 | <i>Ipomoea aquatic</i> | 100.00 | 99.43 | 99.71 |
| 7 | <i>Marsilea minuta</i> | 98.80 | 98.80 | 98.80 |
| 8 | <i>Panicum repens</i> | 97.10 | 97.10 | 97.10 |
| 9 | <i>Paspalum scrobiculatum</i> | 98.94 | 100.00 | 99.47 |
| 10 | <i>Pteris vittata</i> | 100.00 | 100.00 | 100.00 |
| 11 | <i>Synedrella nodiflora</i> | 94.50 | 100.00 | 97.17 |

- Obtained accuracy of DenseNet model is 98%
- Confusion matrix for DenseNet is stated below:

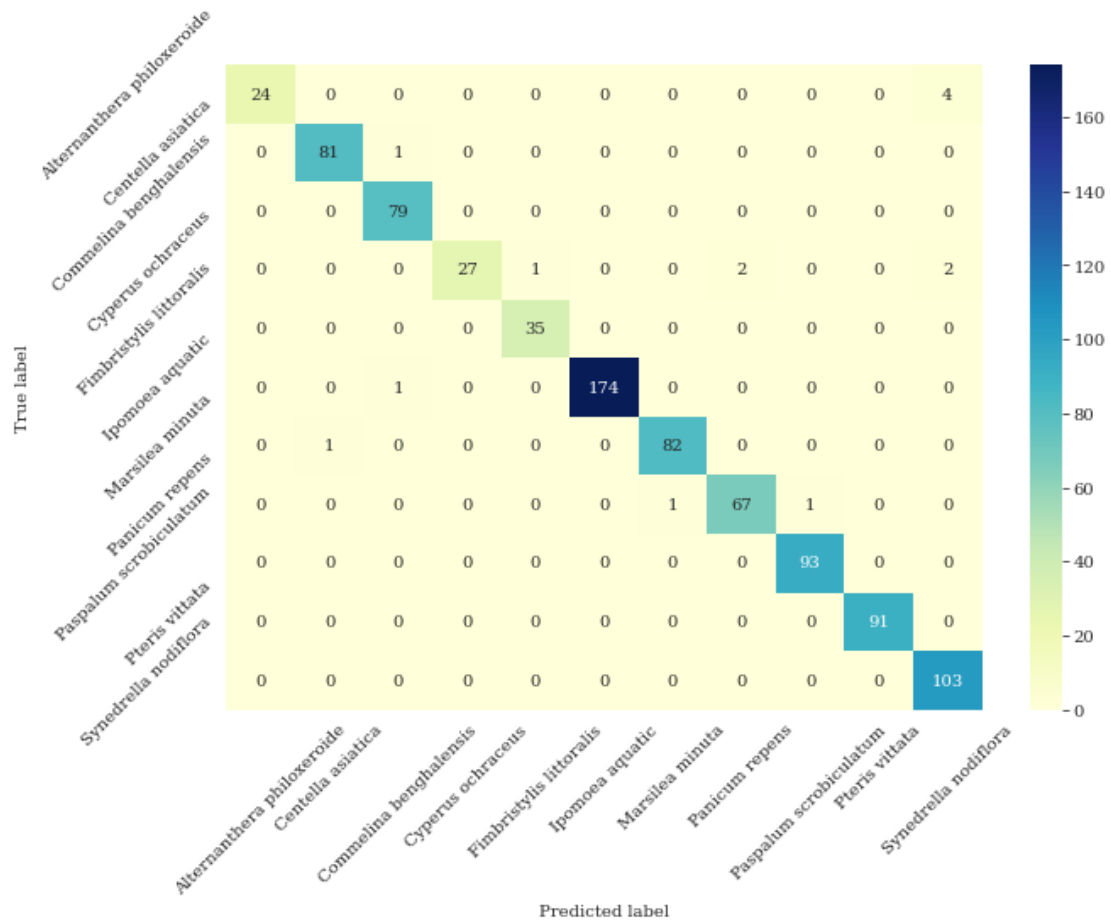


Figure-1: Confusion Matrix for DenseNet

- ROC AUC score of DenseNet is 0.9829 and the corresponding curve is:

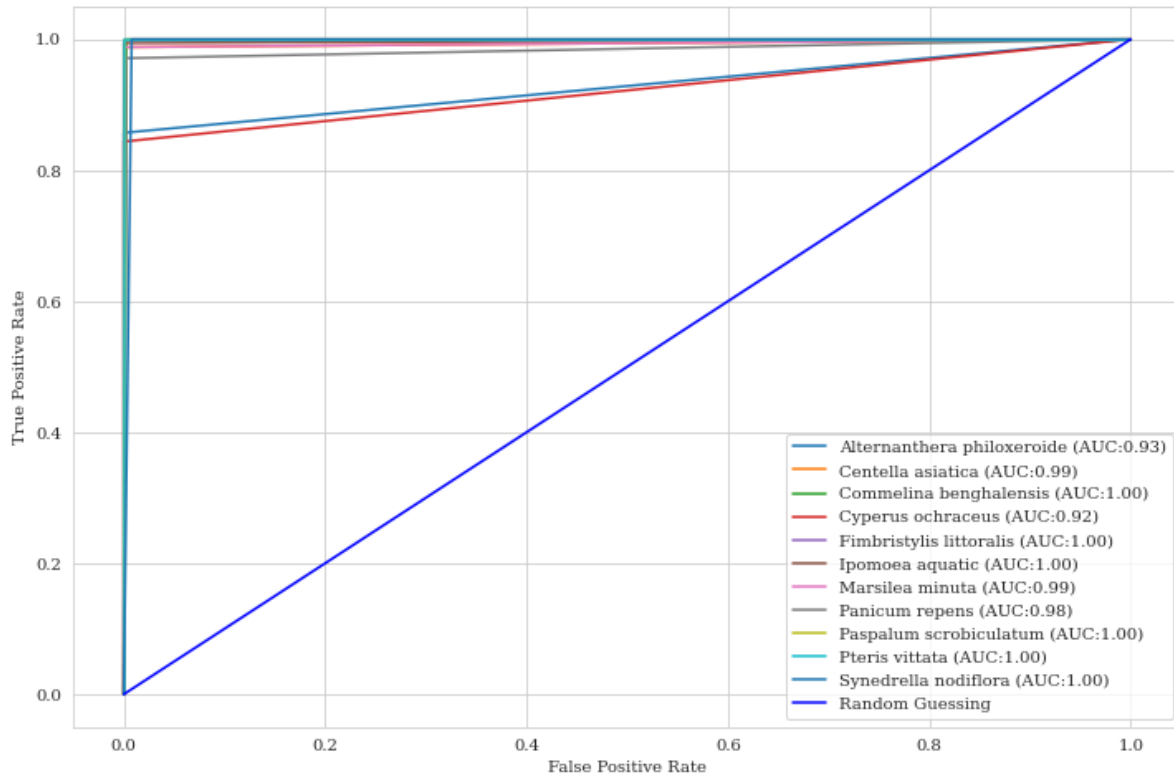


Figure-1: ROC AUC curve for VGG16

Figure-1: Some prediction of VGG16 model