Model Comparison Documentation

1. Introduction

This documentation compares the performance of three deep learning models:

1. **ResNet18** (implemented from scratch)
2. **DenseNet** (imported from libraries)
3. **Xception** (imported from libraries)

The evaluation focuses on the following metrics:

- ROC-AUC (Receiver Operating Characteristic - Area Under Curve)
- Accuracy
- Loss curves (training and validation)
- Confusion matrix

The comparison helps assess the effectiveness and generalization ability of these models for a given classification task.

2. Models Overview

2.1 ResNet18 (Implemented from Scratch)

ResNet18 is a variant of the ResNet (Residual Network) architecture. It utilizes residual blocks with skip connections to address the vanishing gradient problem in deep networks. For this study, ResNet18 was implemented from scratch, including the custom definition of layers and residual blocks.

2.2 DenseNet (Imported)

DenseNet (Densely Connected Convolutional Network) connects each layer to every other layer in a feed-forward manner. The architecture enhances feature propagation and reduces redundancy.

- **Source**: Predefined architecture from deep learning libraries like TensorFlow/Keras or PyTorch.

2.3 Xception (Imported)

Xception (Extreme Inception) is a deep learning architecture that replaces standard Inception modules with depthwise separable convolutions, improving computational efficiency.

- **Source**: Imported from frameworks such as Keras or PyTorch

3. Evaluation Metrics

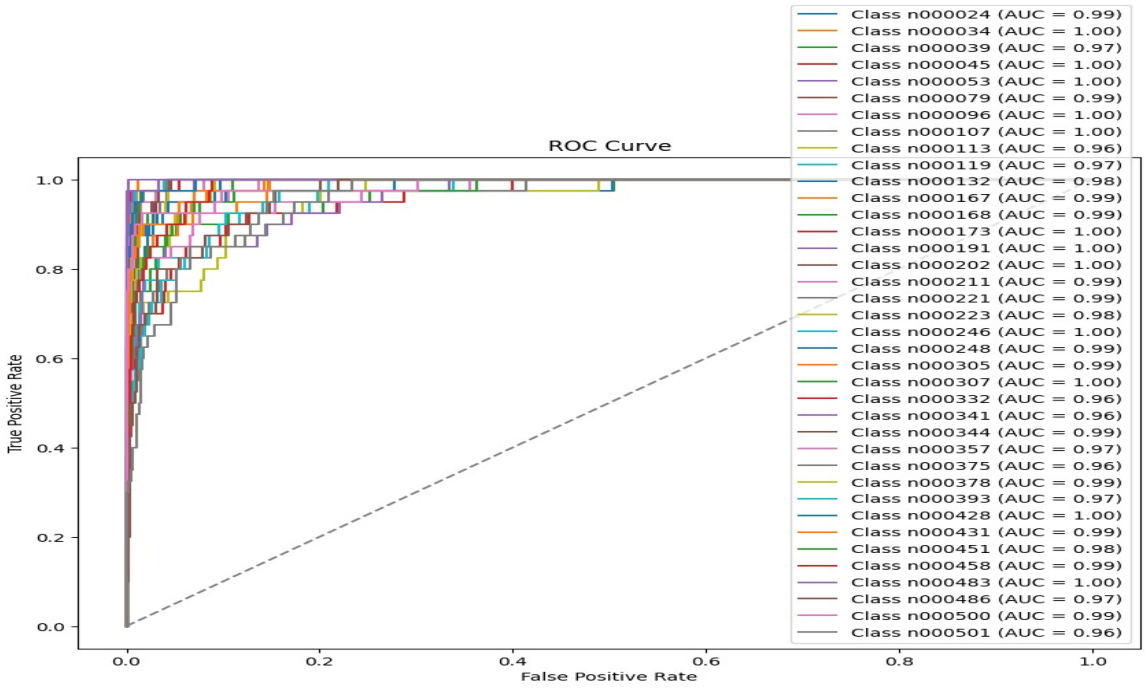
The following evaluation metrics were used to compare the models:

- **ROC-AUC**: Measures the area under the ROC curve, which evaluates model performance across all classification thresholds.
- **Accuracy**: The ratio of correct predictions to total predictions.
- **Loss Curves**: Visual representation of the training and validation loss over epochs.
- **Confusion Matrix**: Summarizes true positives, false positives, true negatives, and false negatives.

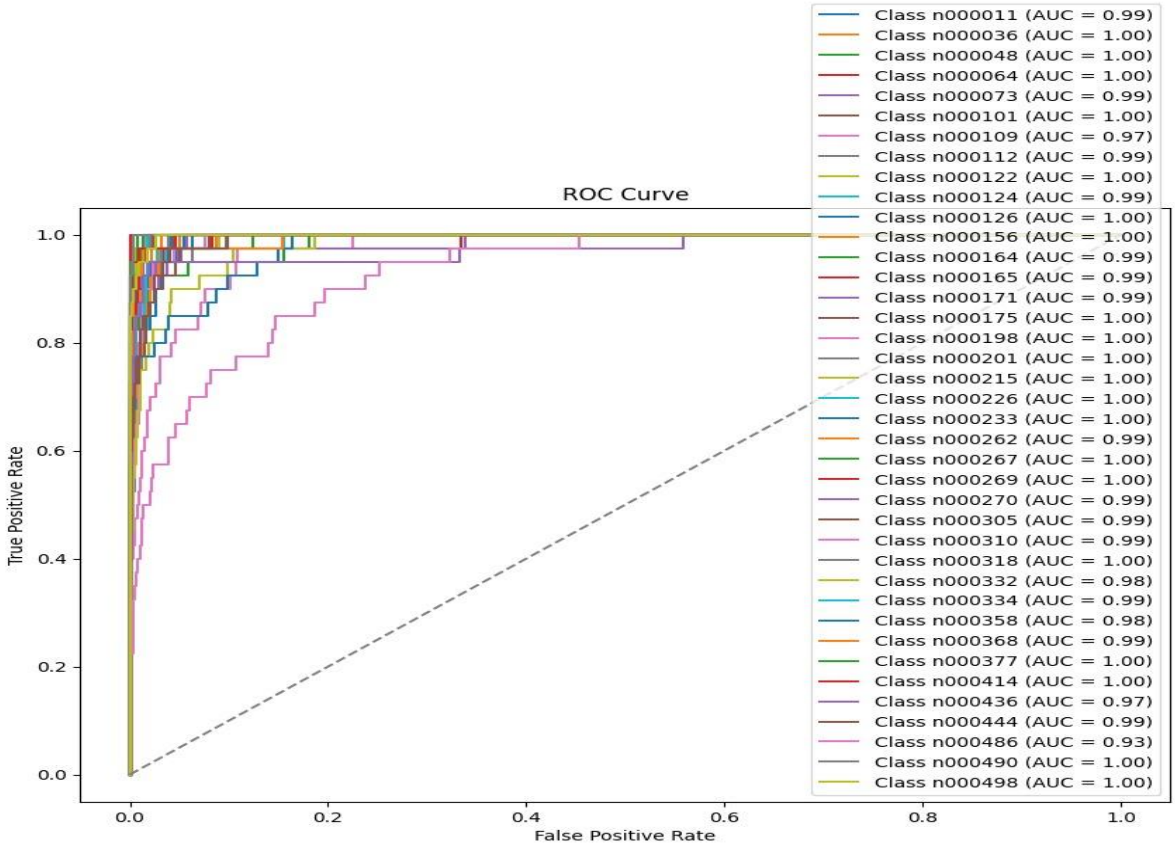
4. Results

4.1 ROC (AUC)

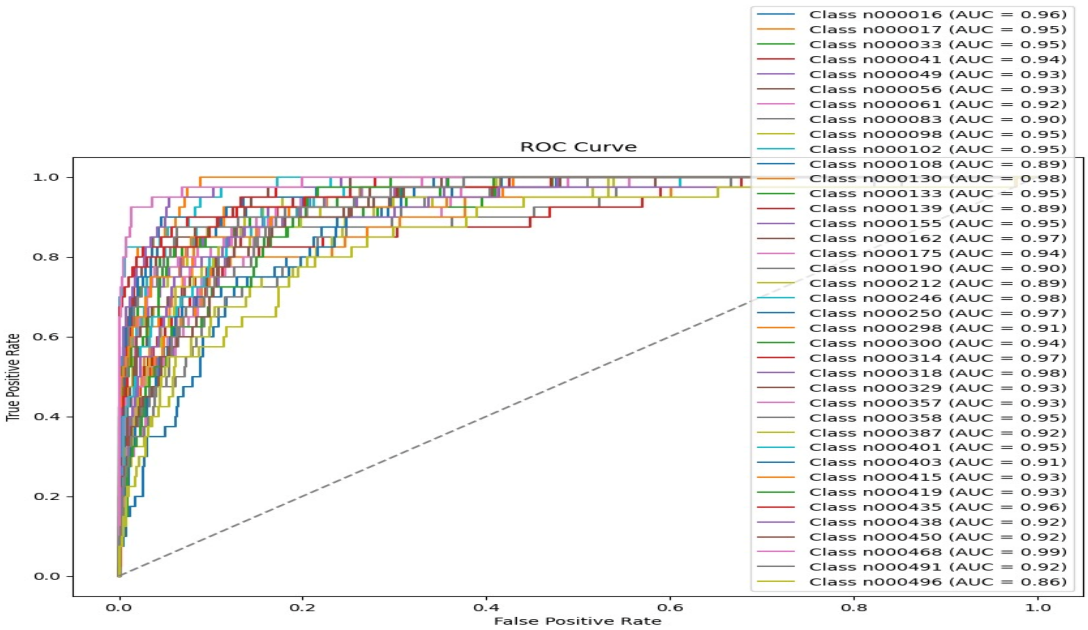
4.1.1 ResNet18



4.1.2 DenseNet

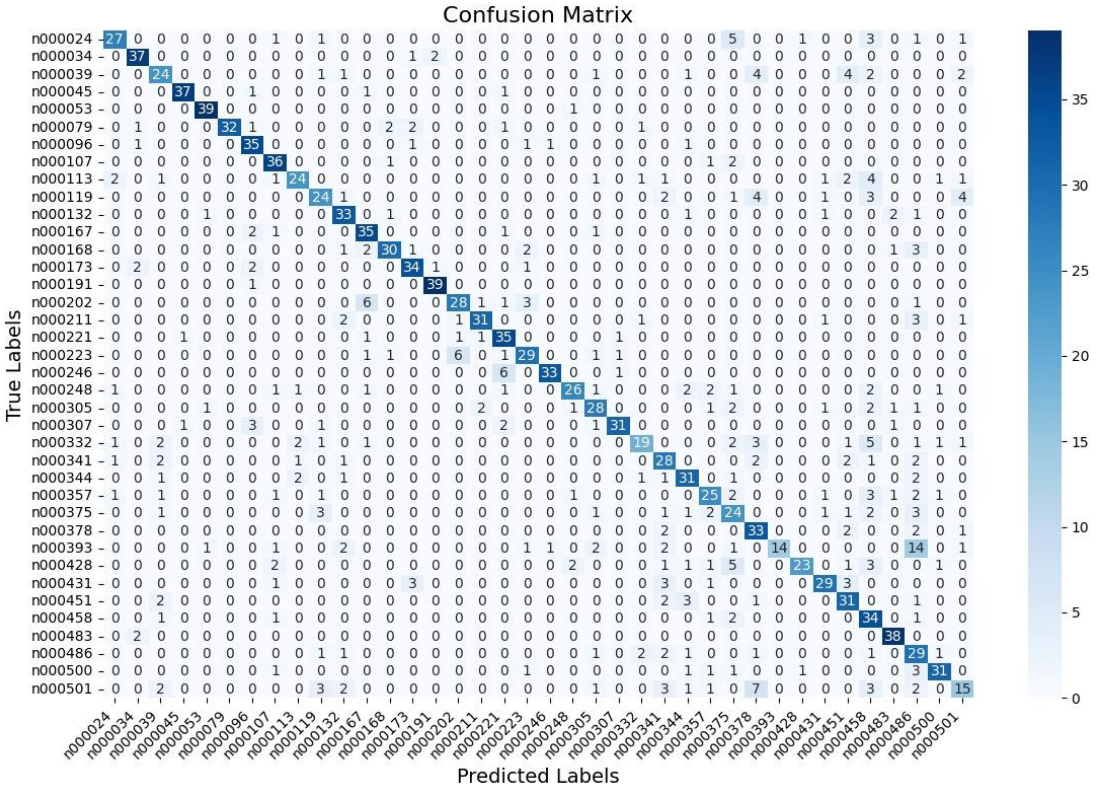


4.1.3 Xception

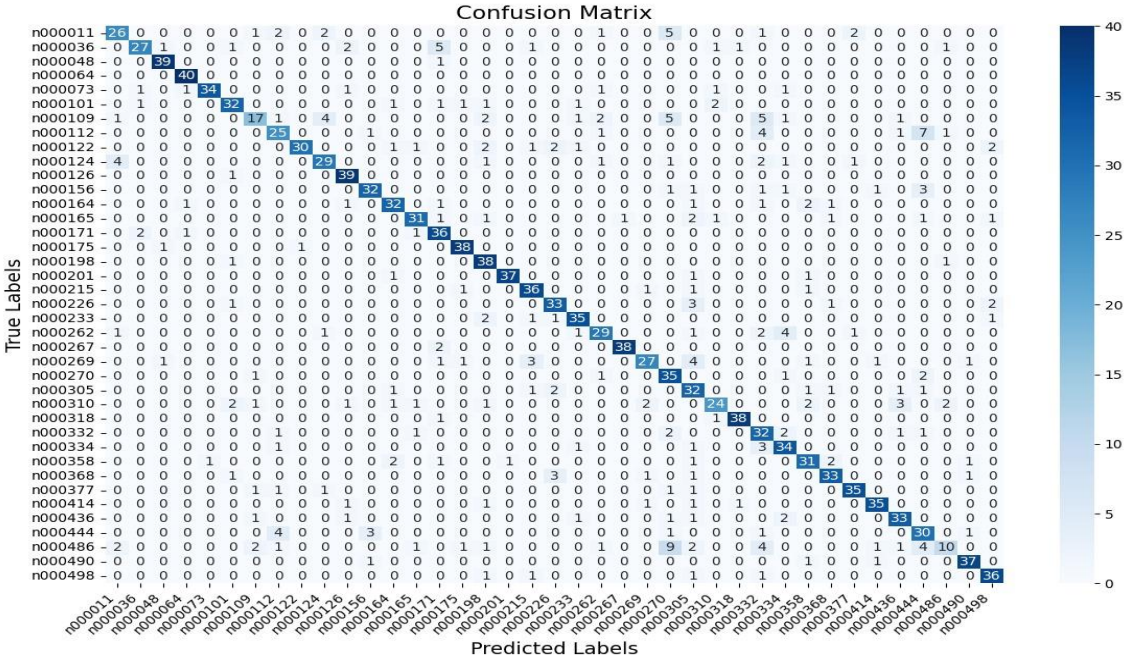


4.2 Confusion Matrix

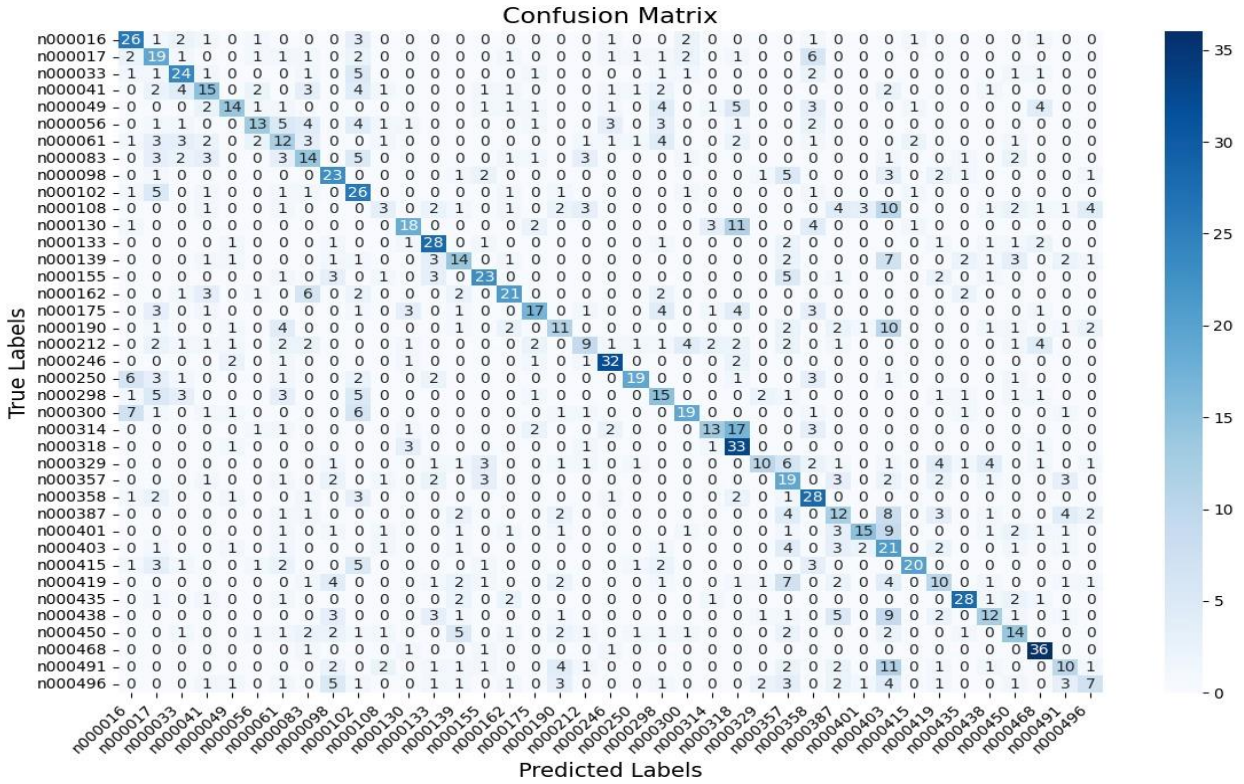
4.2.1 ResNet18



4.2.2 DenseNet

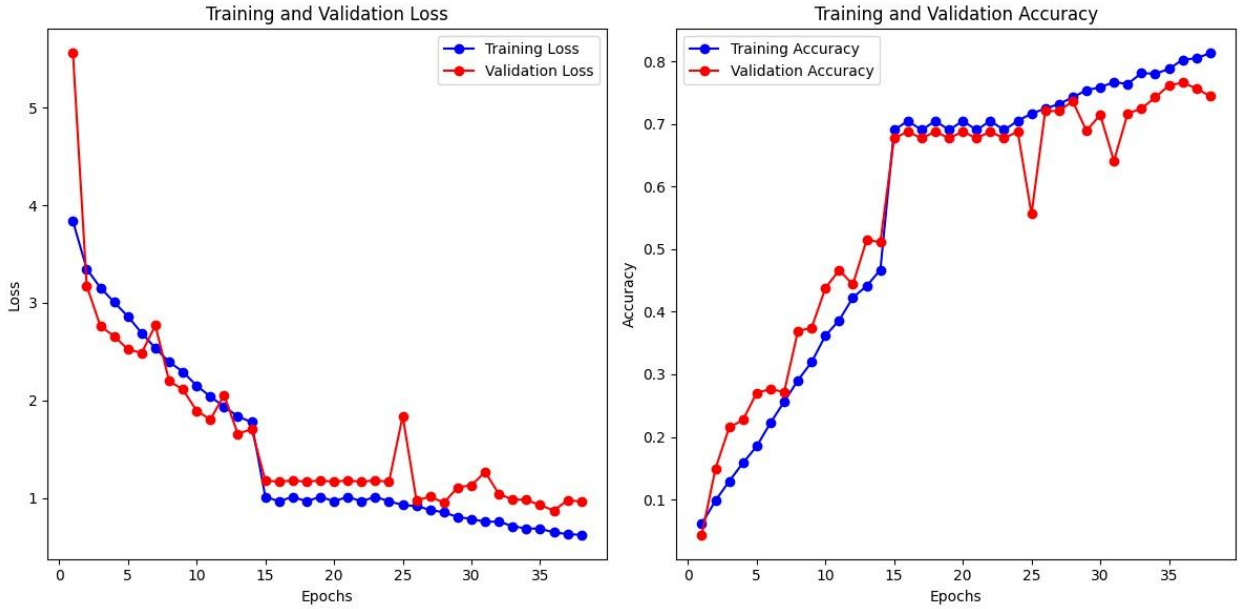


4.2.3 Xception

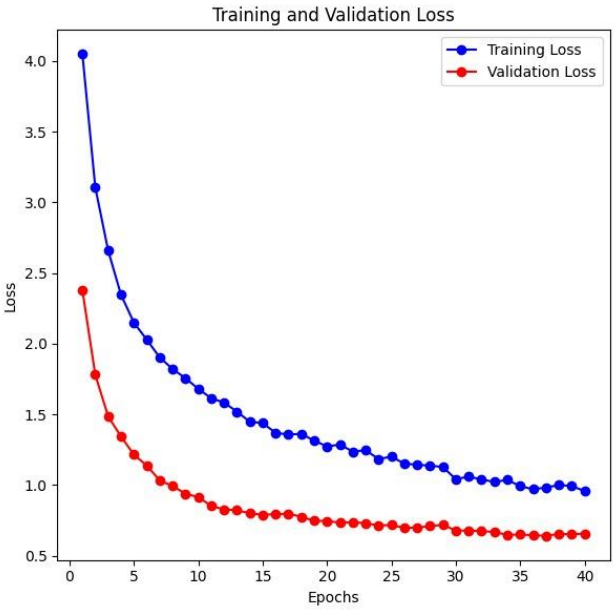


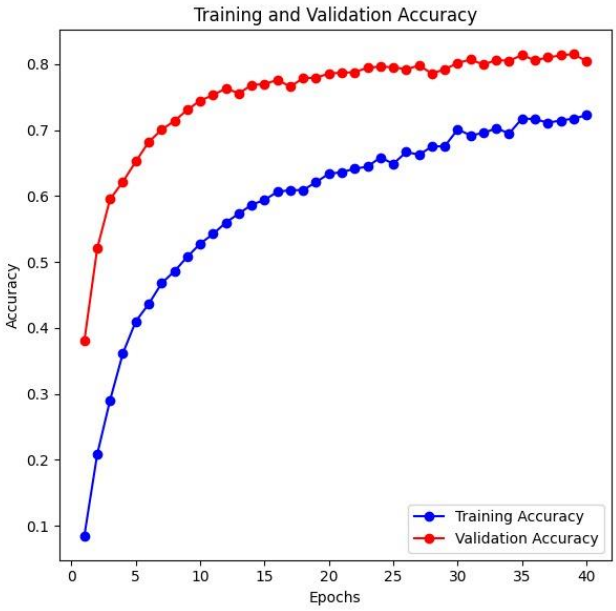
4.3 Accuracy and loss curves

4.3.1 ResNet18

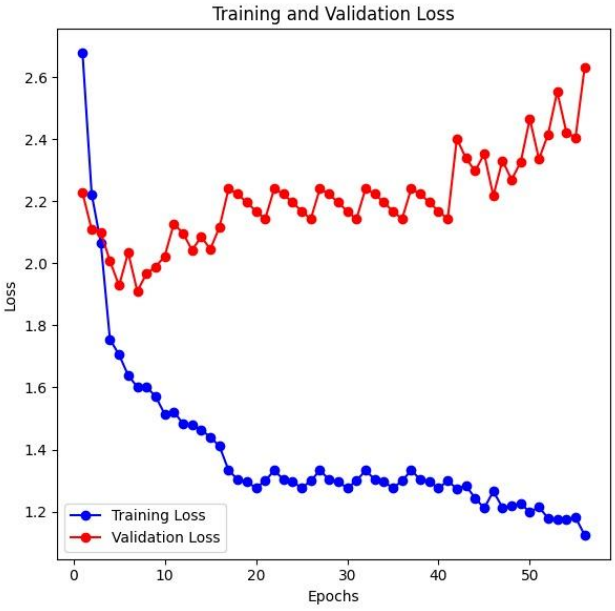


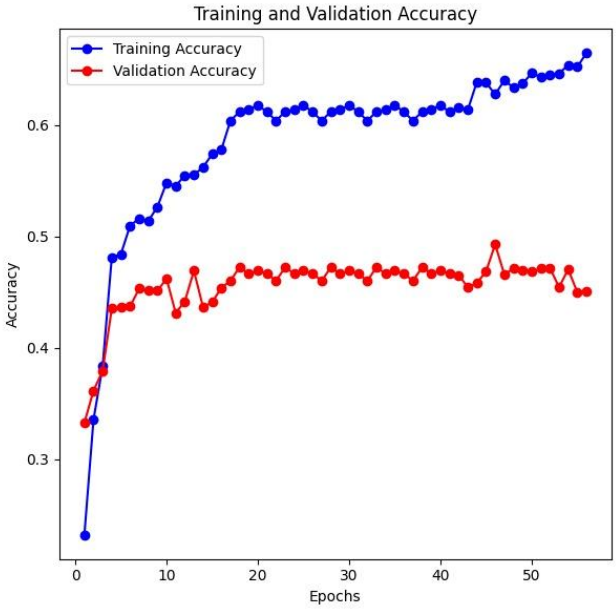
4.3.2 DenseNet





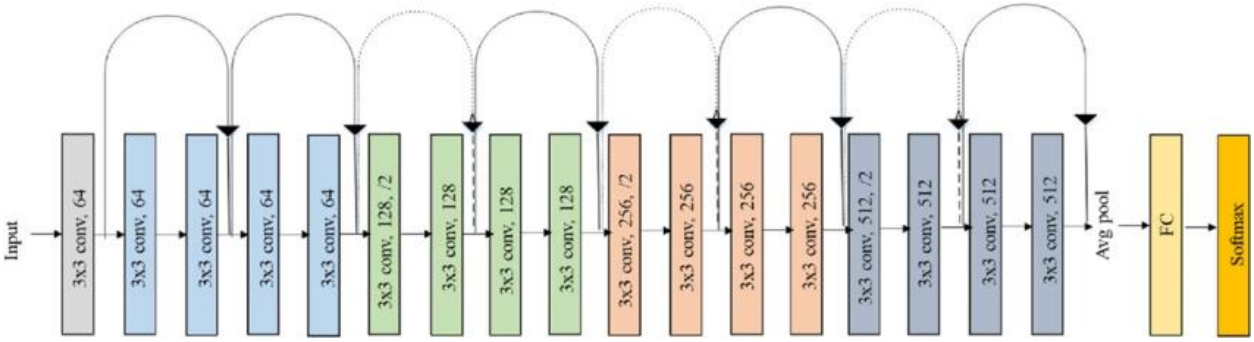
4.3.3 Xception



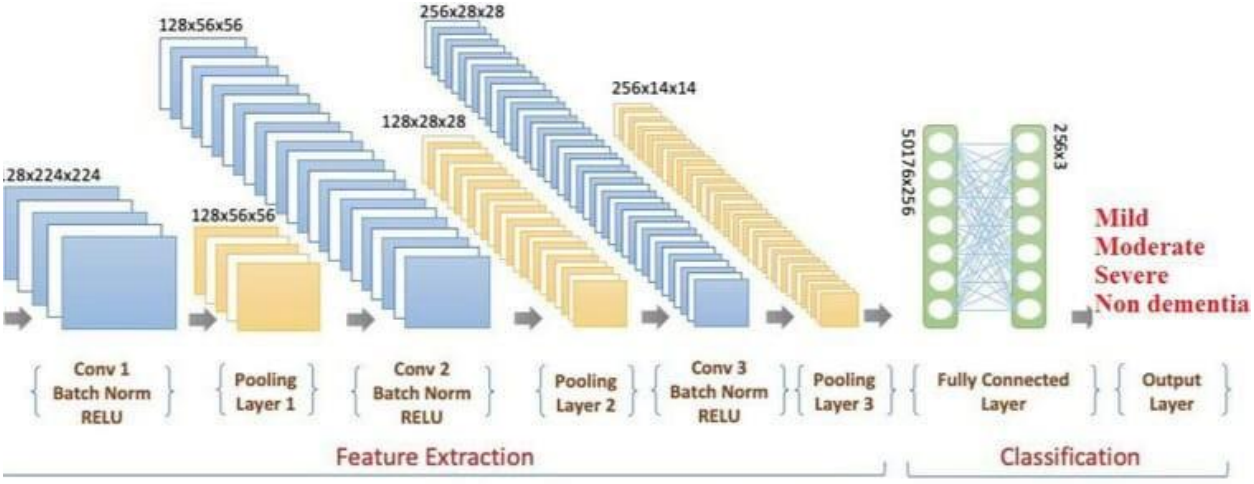


4.4 Architectures

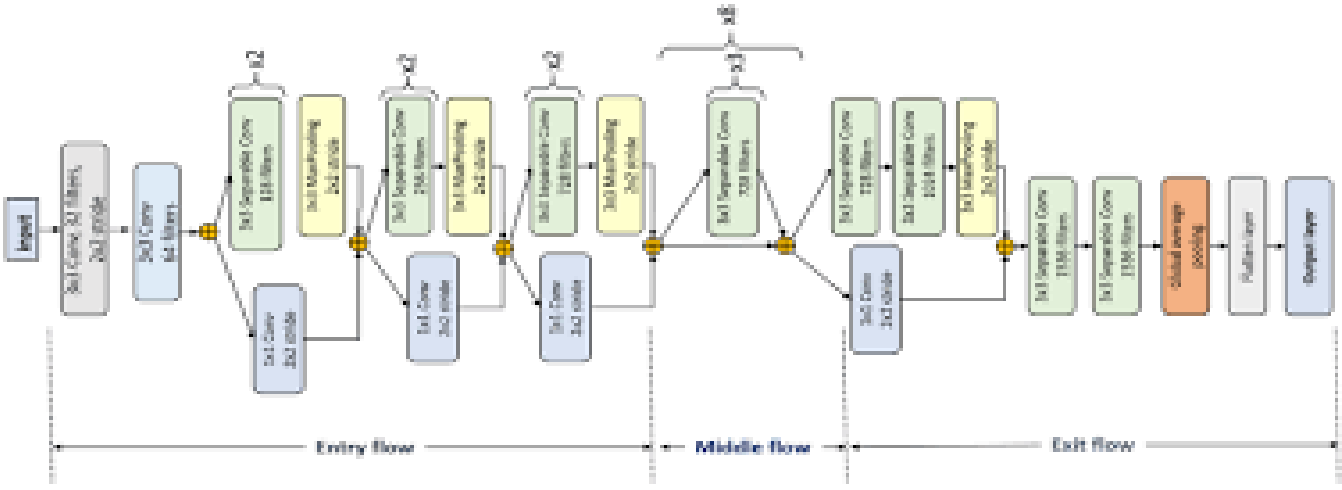
4.4.1 ResNet18



4.4.2 DenseNet



4.4.3 Xception



5.GitHub repository

Link: [https://github.com/gamal101/DeepLearningModels/tree/main]

6.References

ResNet: [https://arxiv.org/abs/1512.03385]

DenseNet: [https://arxiv.org/abs/1608.06993]

Xception: [https://arxiv.org/abs/1610.02357]