Comparative study of neural learning methods in the context of brain tumor classification

Classification of Brain Tumors using brain MRIs

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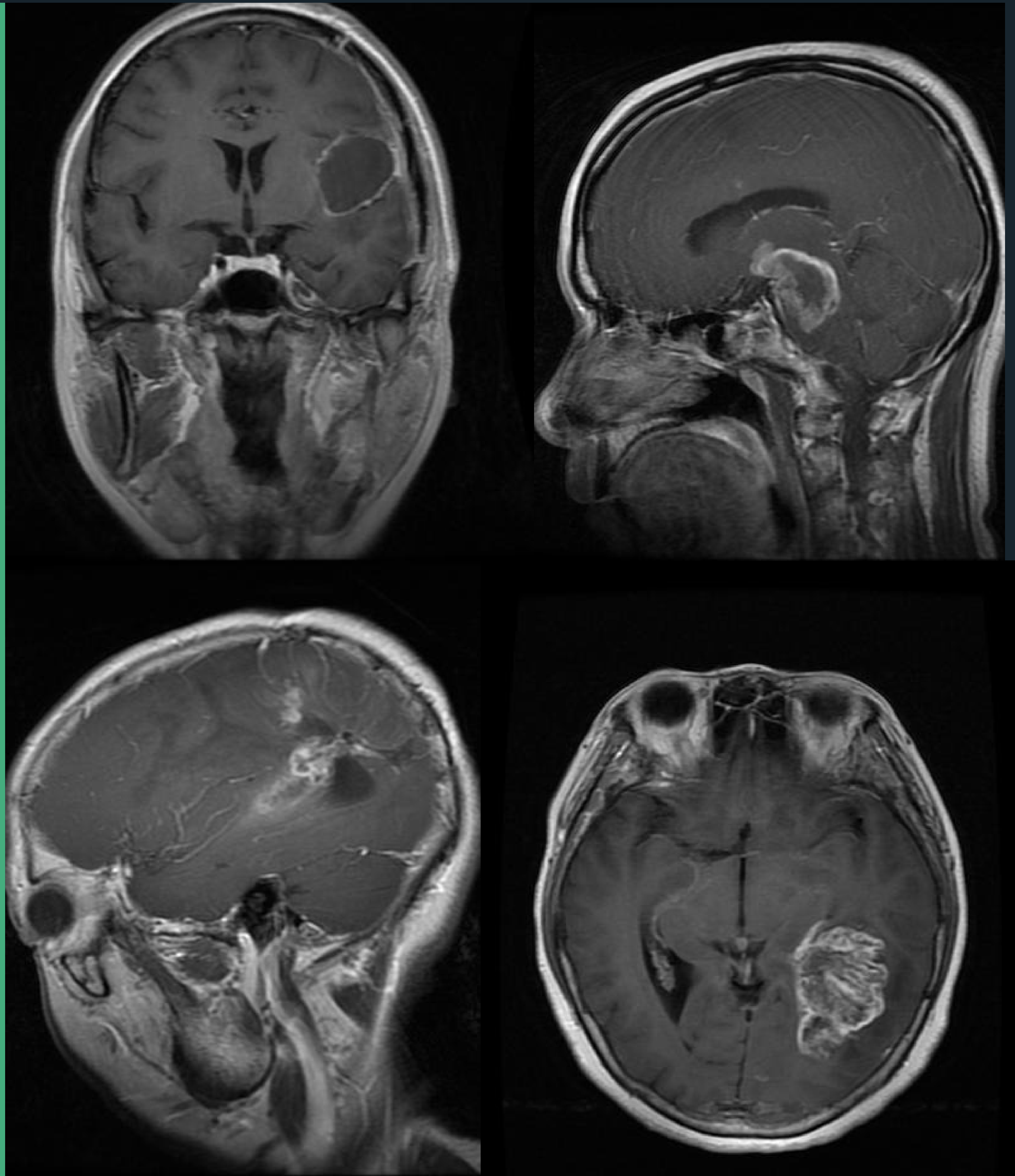
Motivation

- Each year, approximately 70,000-170,000 cancer patients are diagnosed with brain tumors, while ~100,000 will die every year as a result of brain metastases
- Malignant brain tumors cause an average of 20 Years of Potential Life Lost
- Detection and classification of such cancers help us understand the science, evolution, and how best to treat them.



Agenda

Objective

- To classify MR images of the brain into types of tumors
- Compare the results of the models to choose the best model for MR image classification.

EDA and Preprocessing

- Identifying class imbalance
- Grid Plots
- Image Ratios
- Image cropping and re-sizing
- Image augmentation
- Interpolation

Models

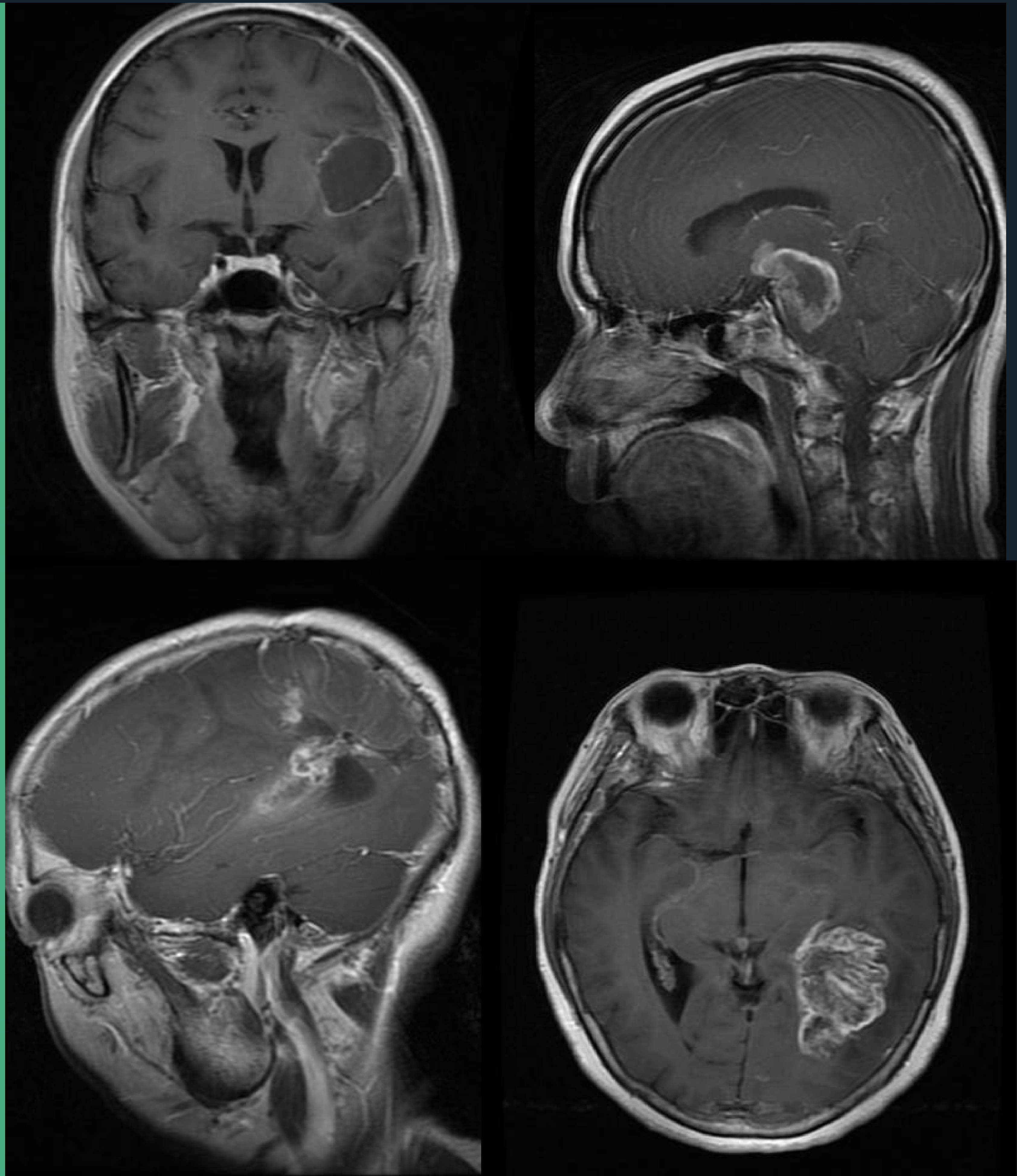
- CNN, VGG16, InceptionV3, Resnet50

Evaluation Metrics

- Loss, Accuracy

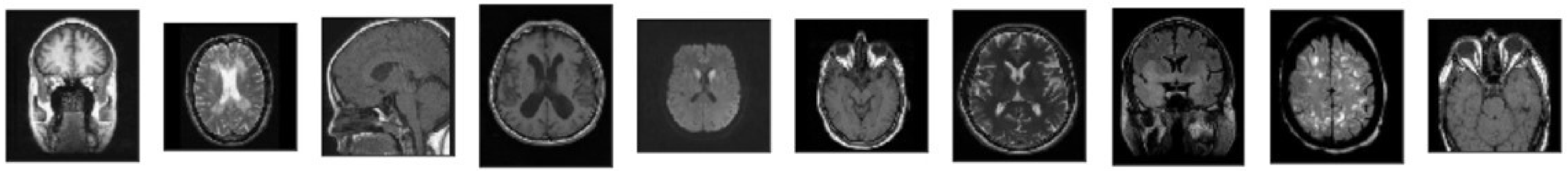
Data Description

- The dataset is a coalition of two different datasets of 3264 and 435 MRI scans of the brain
- They are divided into 4 classes - Glioma Tumor, Meningioma Tumor, Pituitary Tumor and one class of normal tumor free brains
- These 3699 images are used to train and test on the model

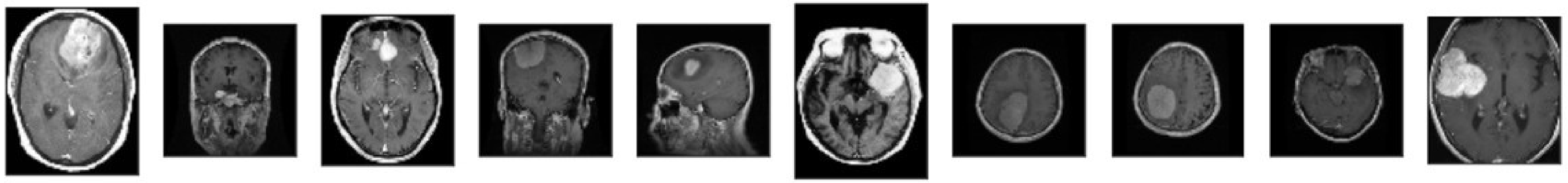


EDA

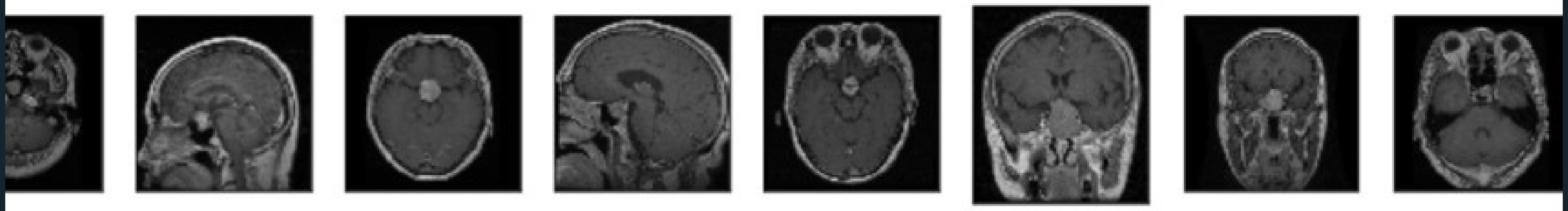
Grid Plots

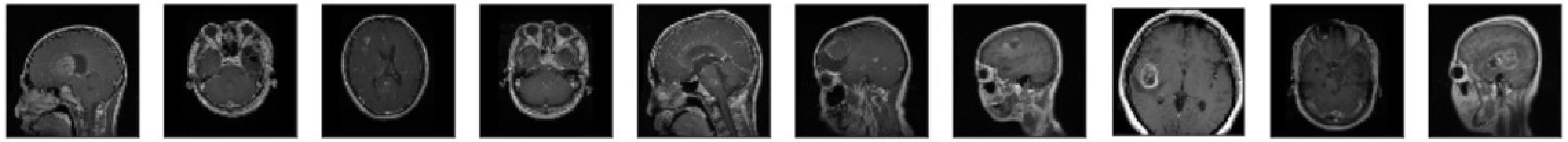


Tumor: PITUITARY_TUMOR



Tumor: NO_TUMOR

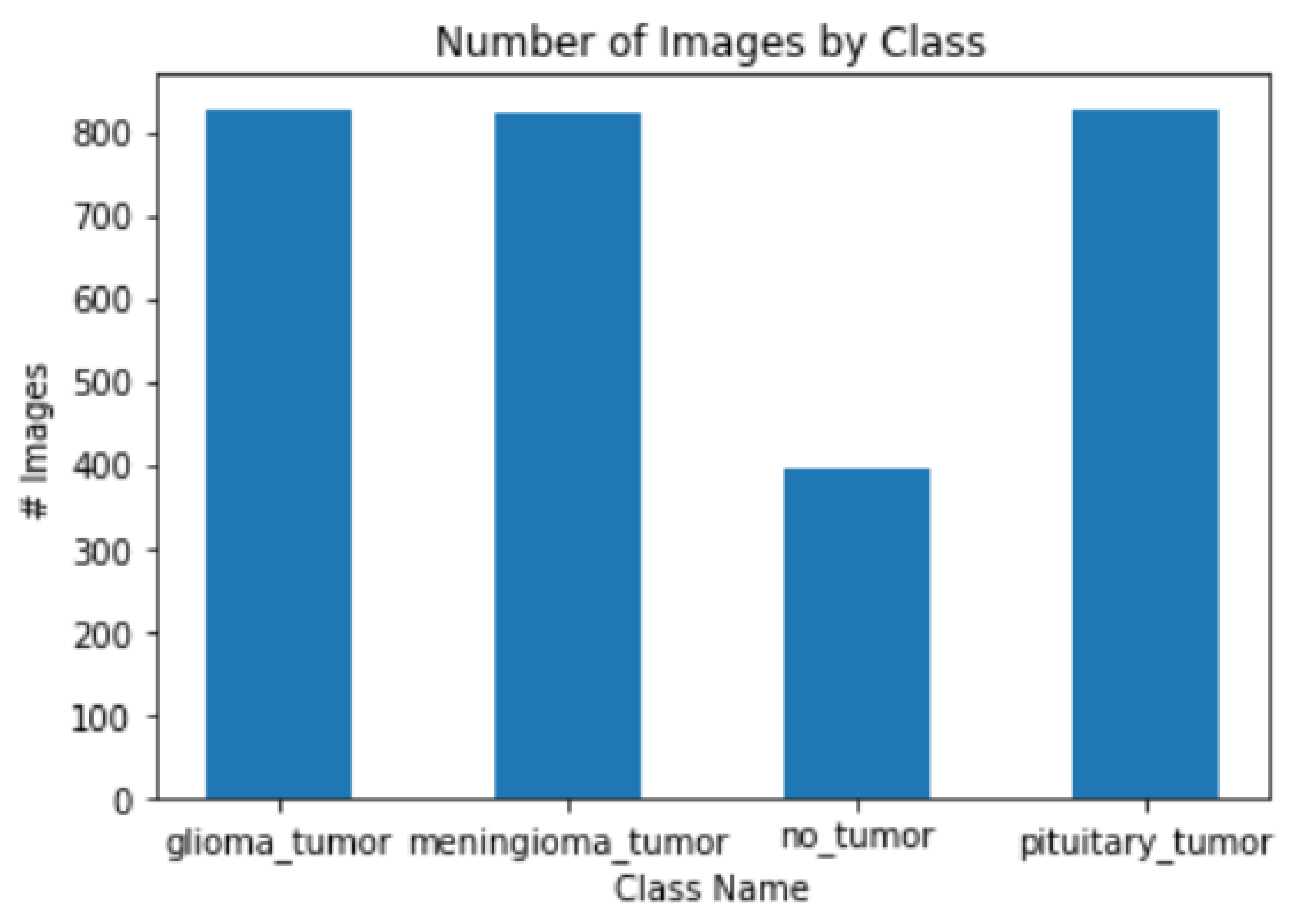


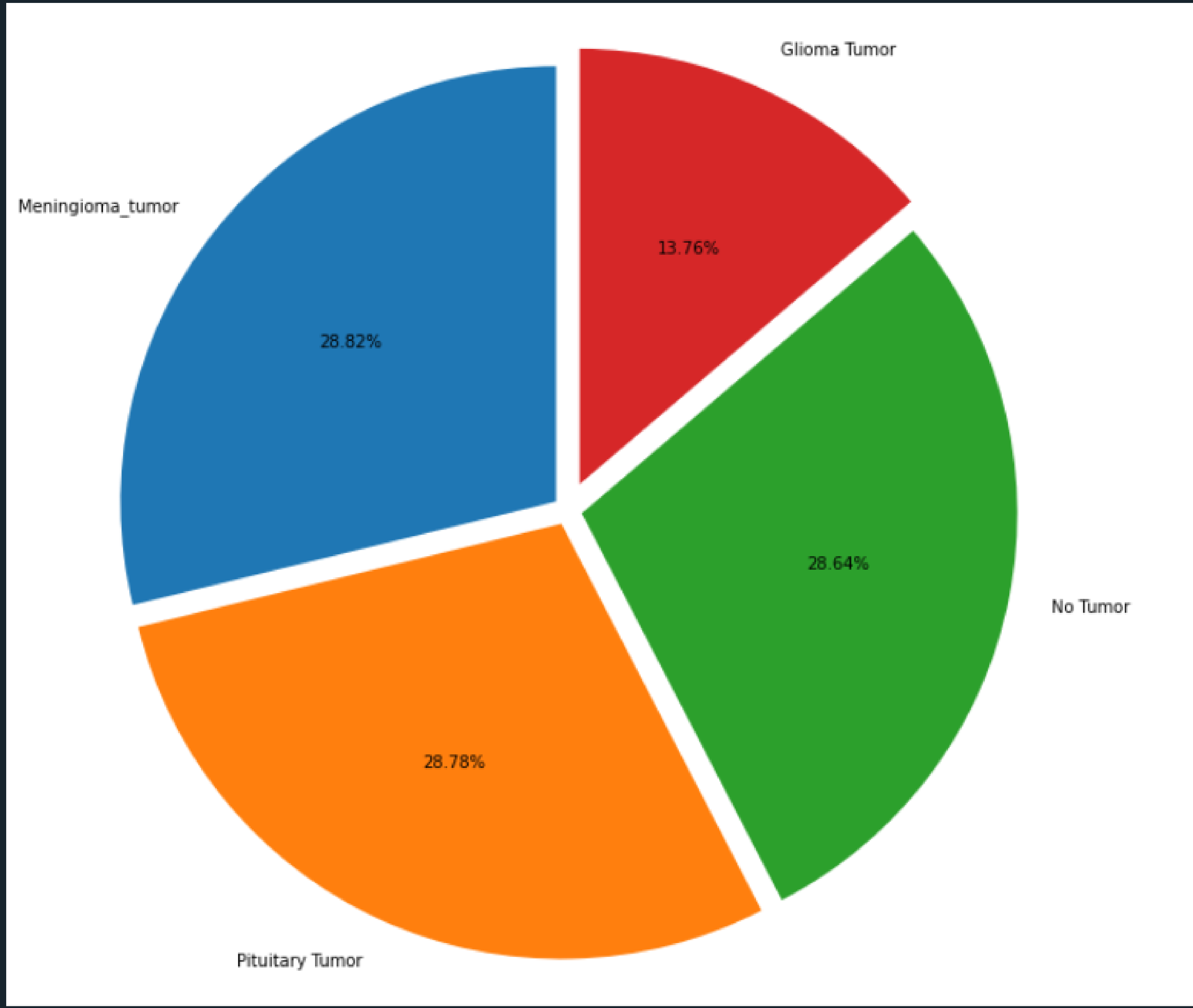


Tumor: MENINGIOMA_TUMOR

EDA

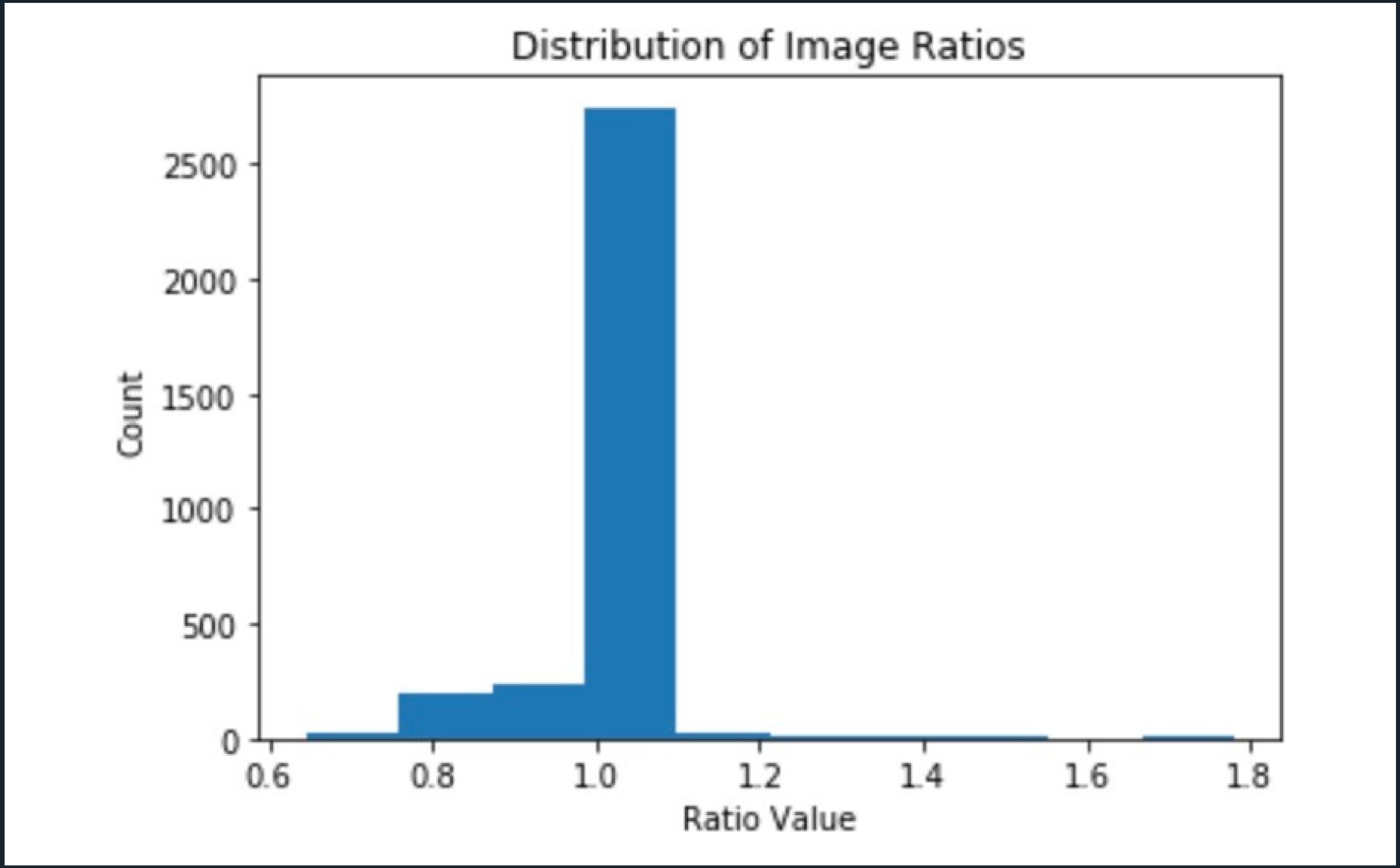
Identifying class imbalance





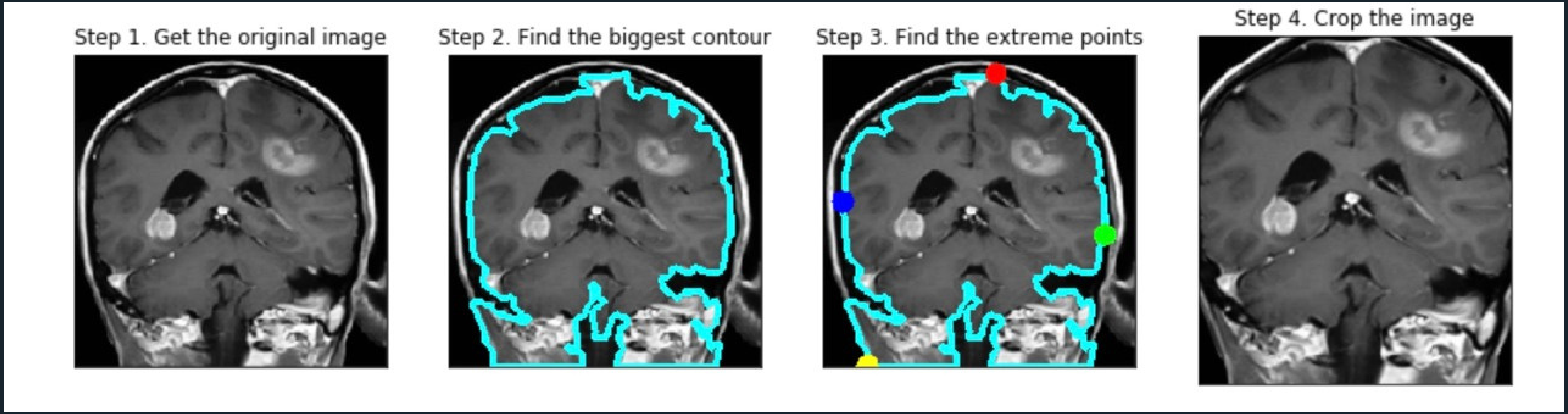
EDA

Image ratio



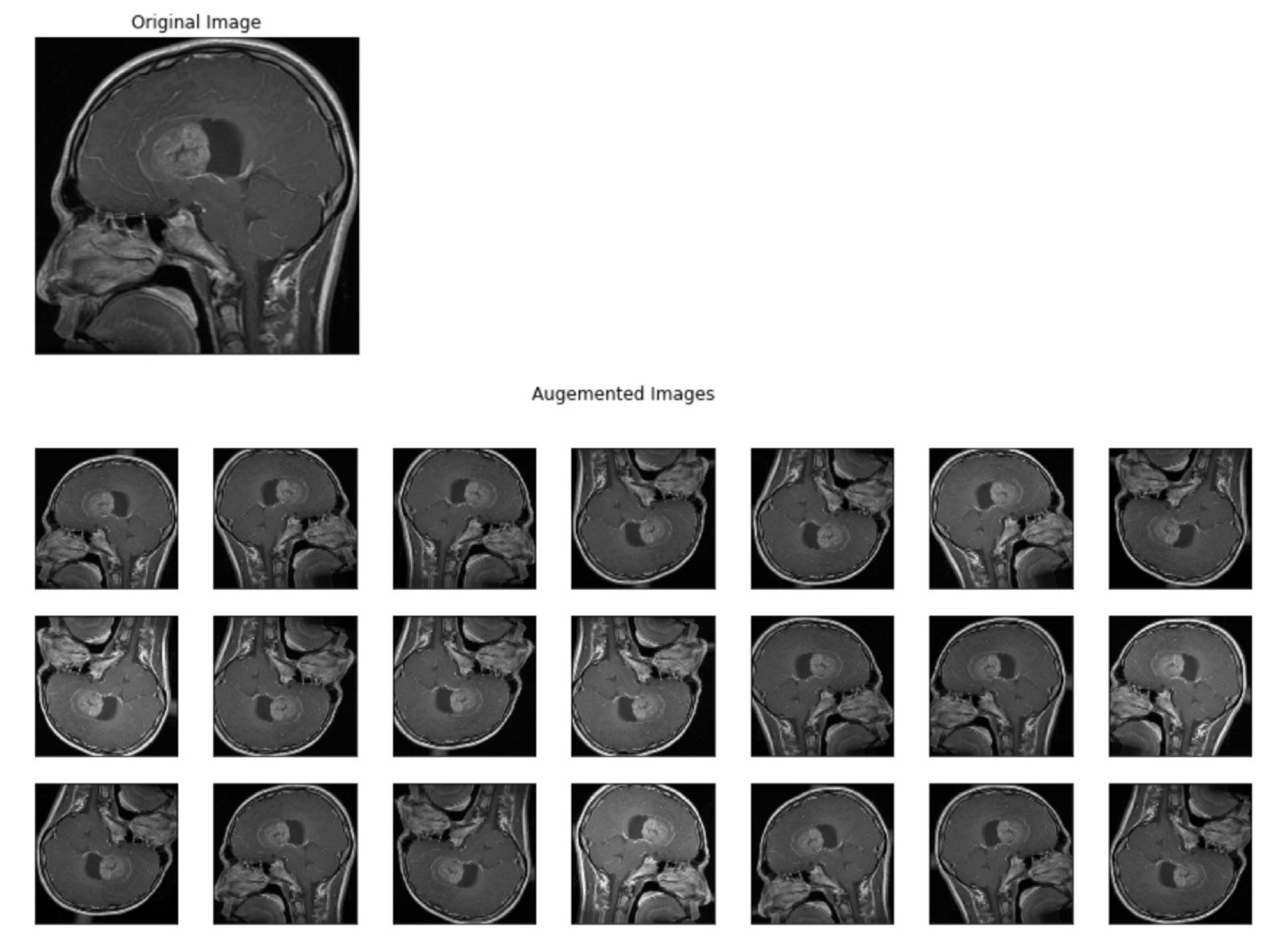
Preprocessing

Image cropping and re-sizing



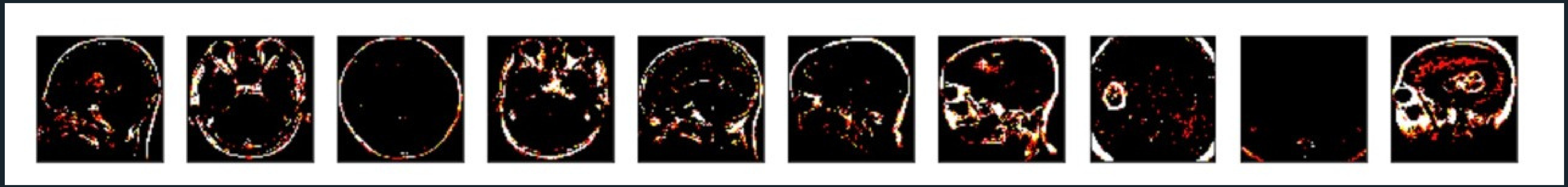
Preprocessing

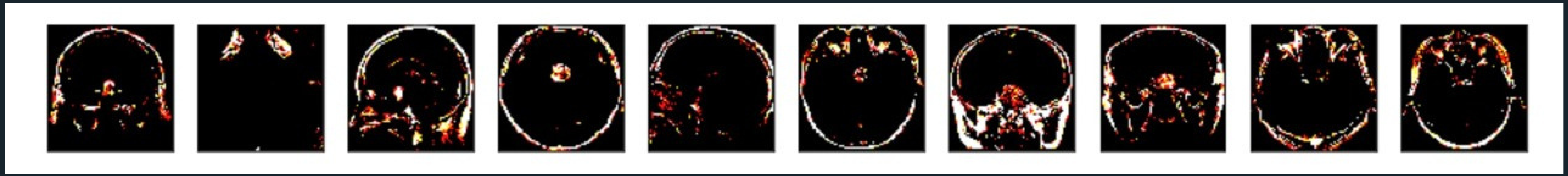
Image Augmentation

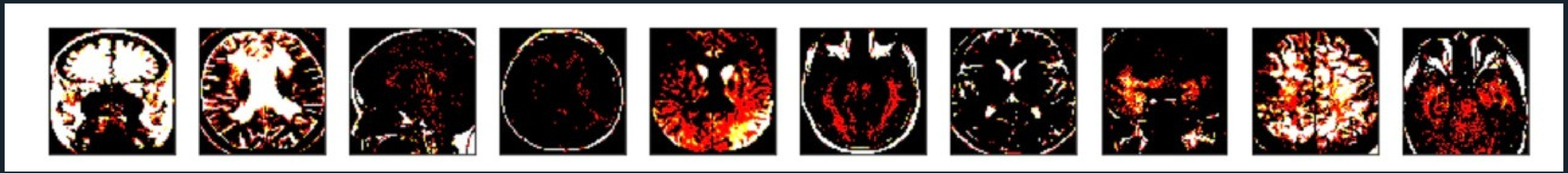


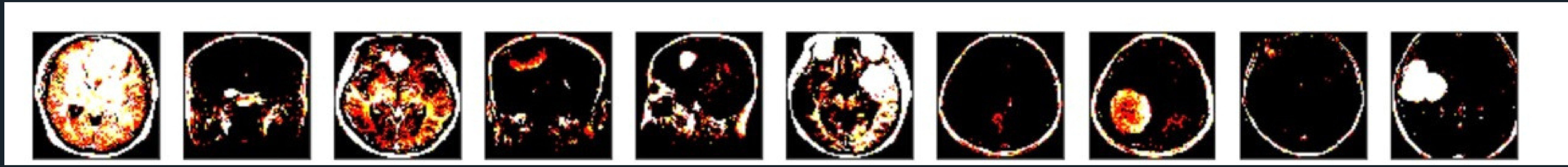
Preprocessing

Image Interpolation



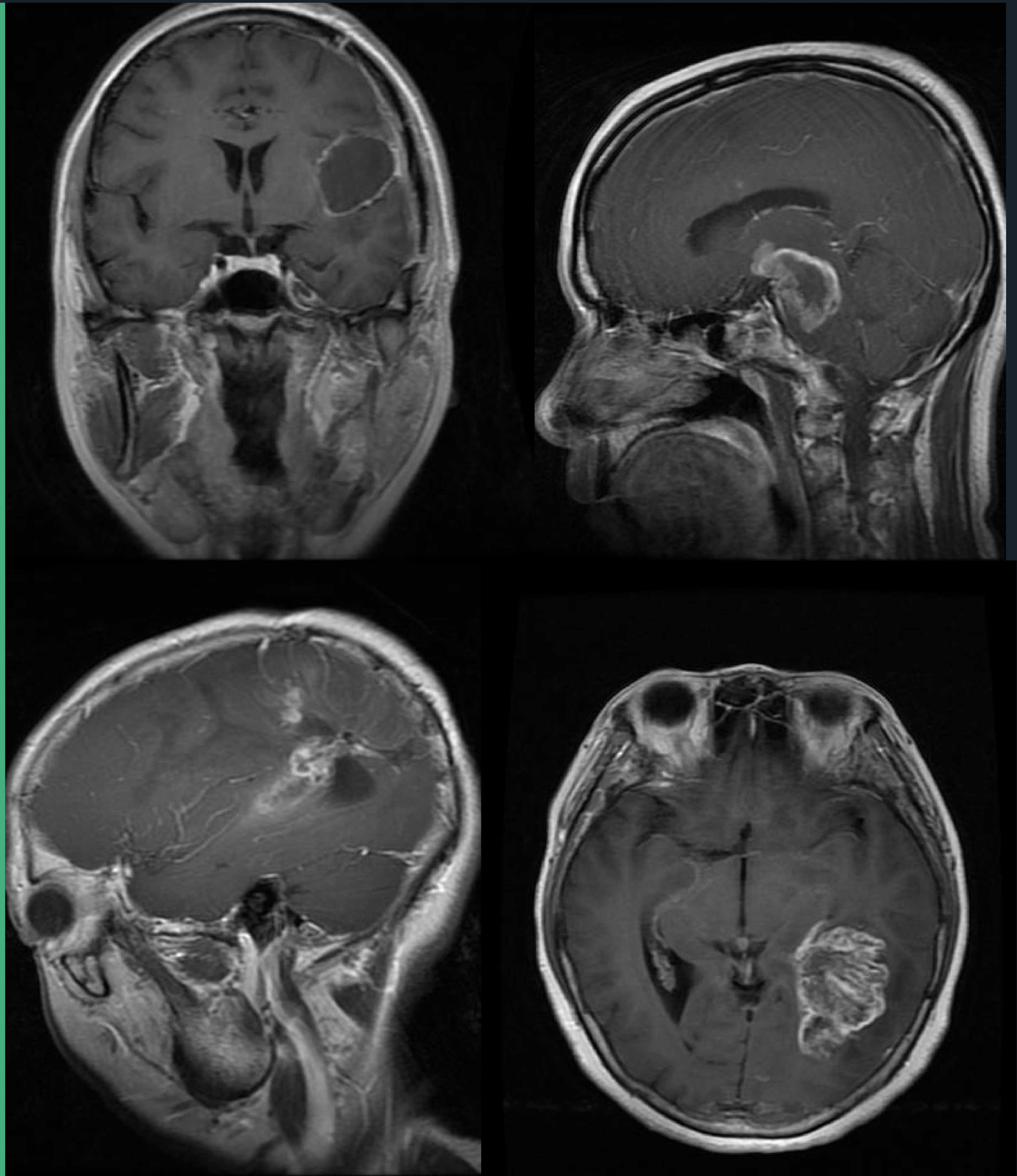




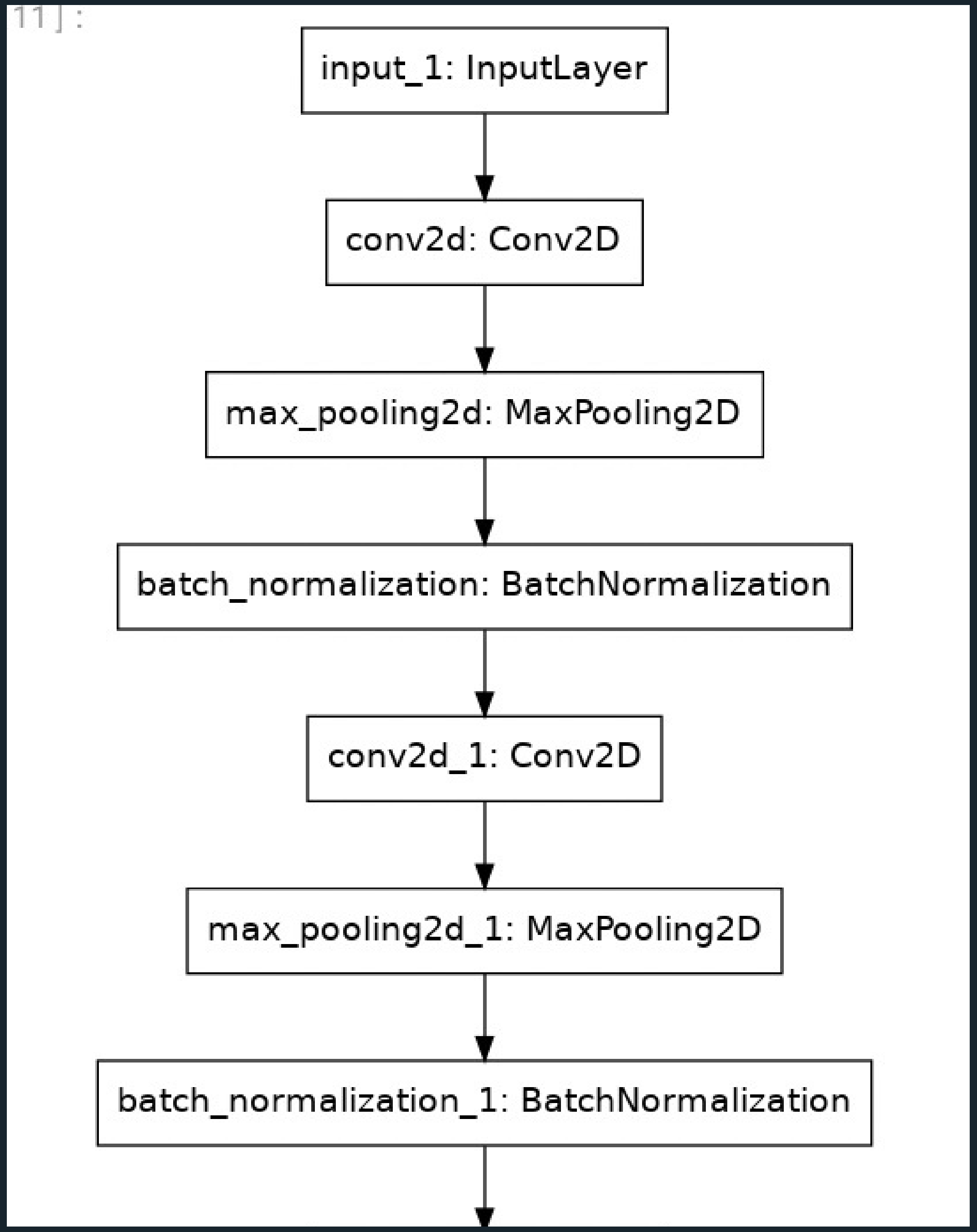


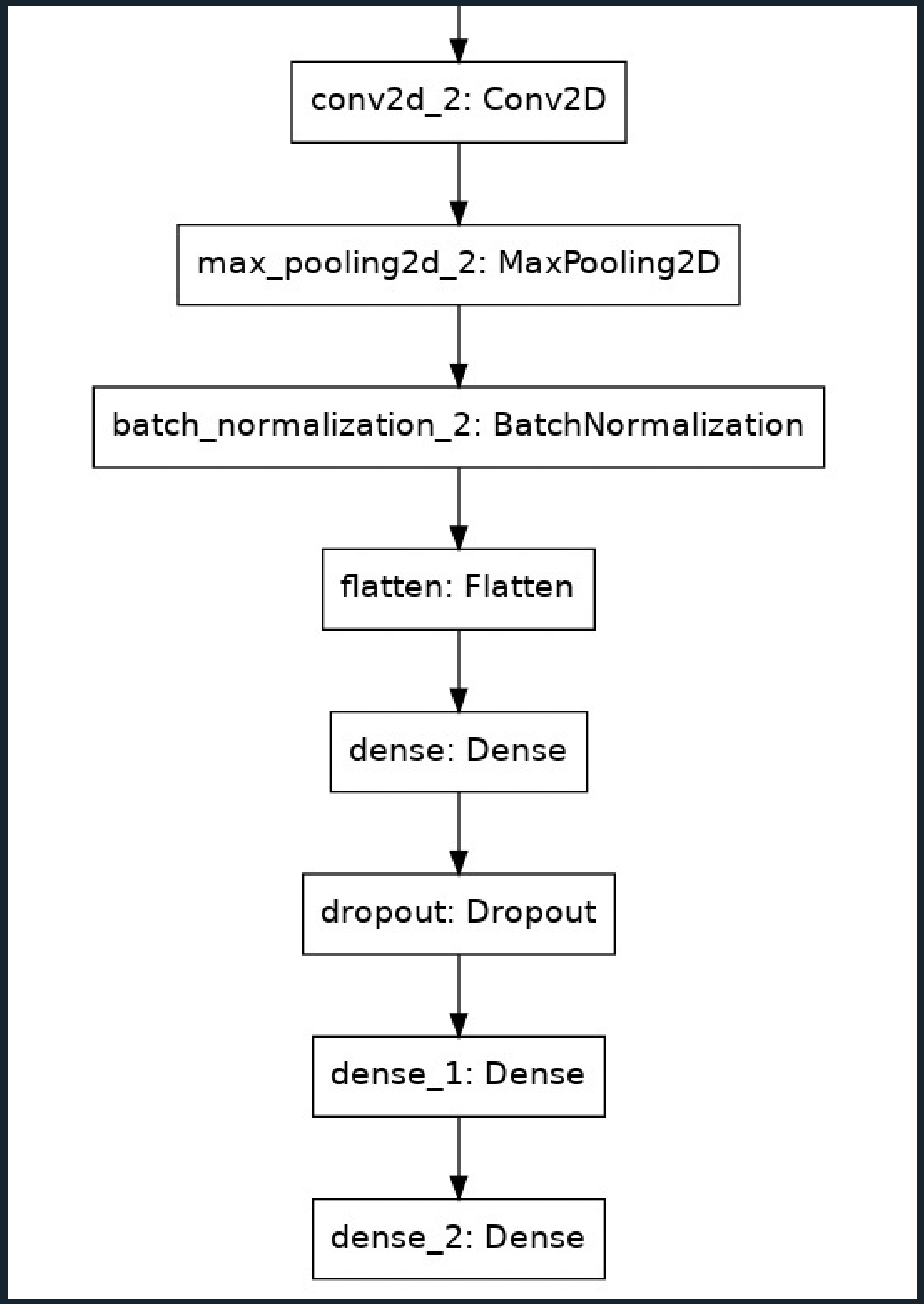
Models

- We are using a Dense CNN as a baseline for our comparison
- Pre-trained models were chosen to compare against the CNN model
- Transfer Learning models VGG16, ResNet 50 and InceptionV3 are used to see how they perform against the same dataset



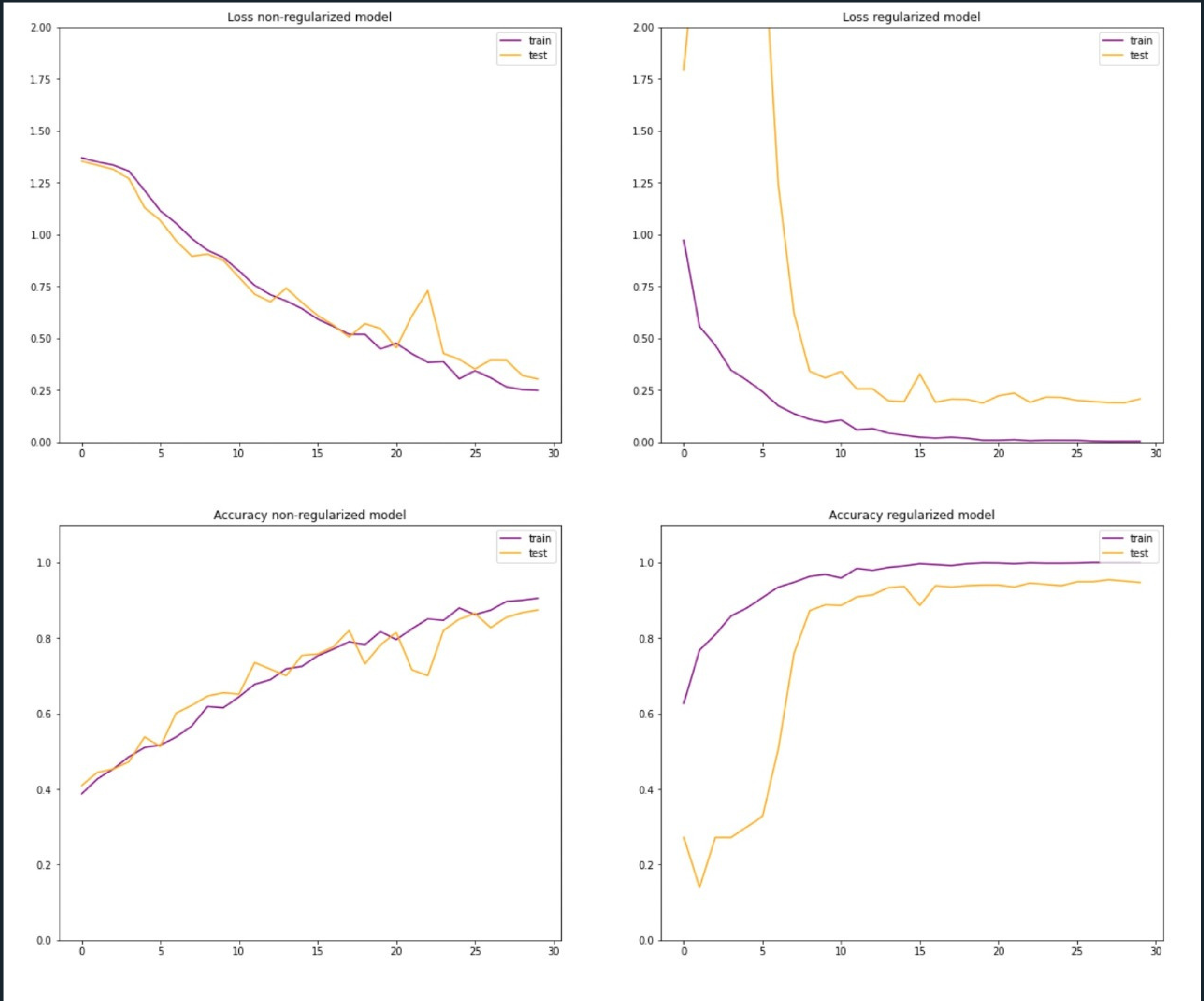
Convolutional Network





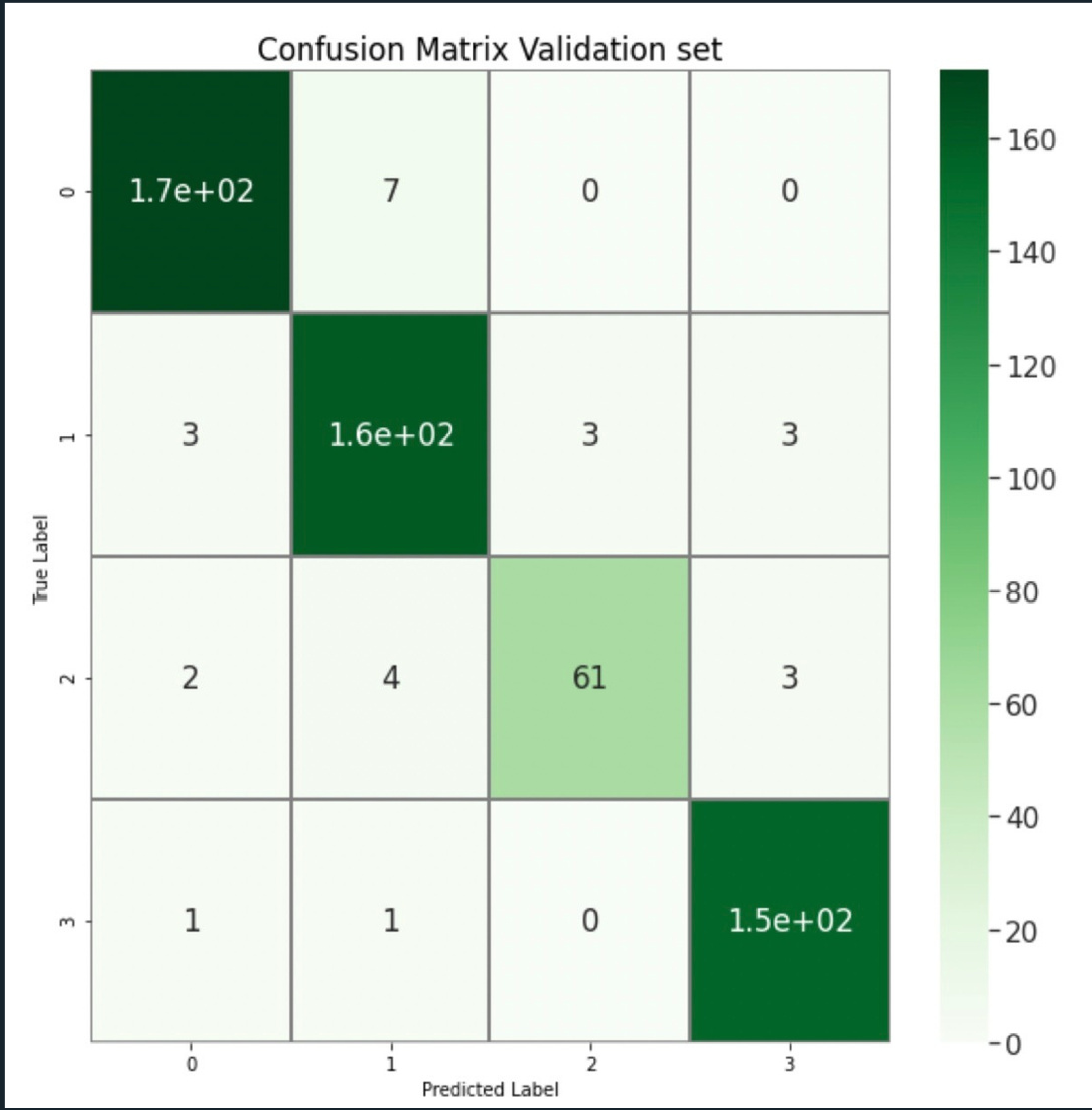
Loss and Accuracy

CNN



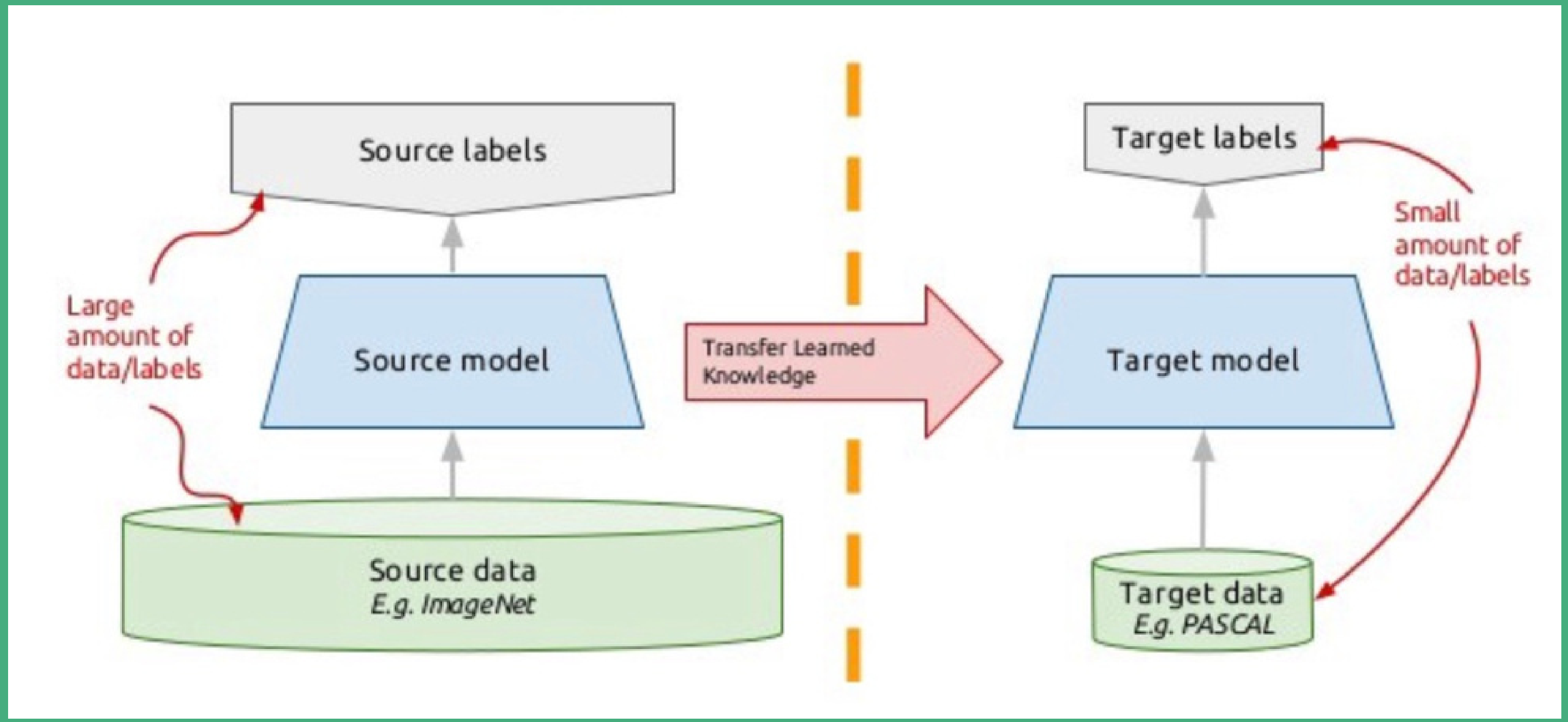
Confusion Matrix

CNN

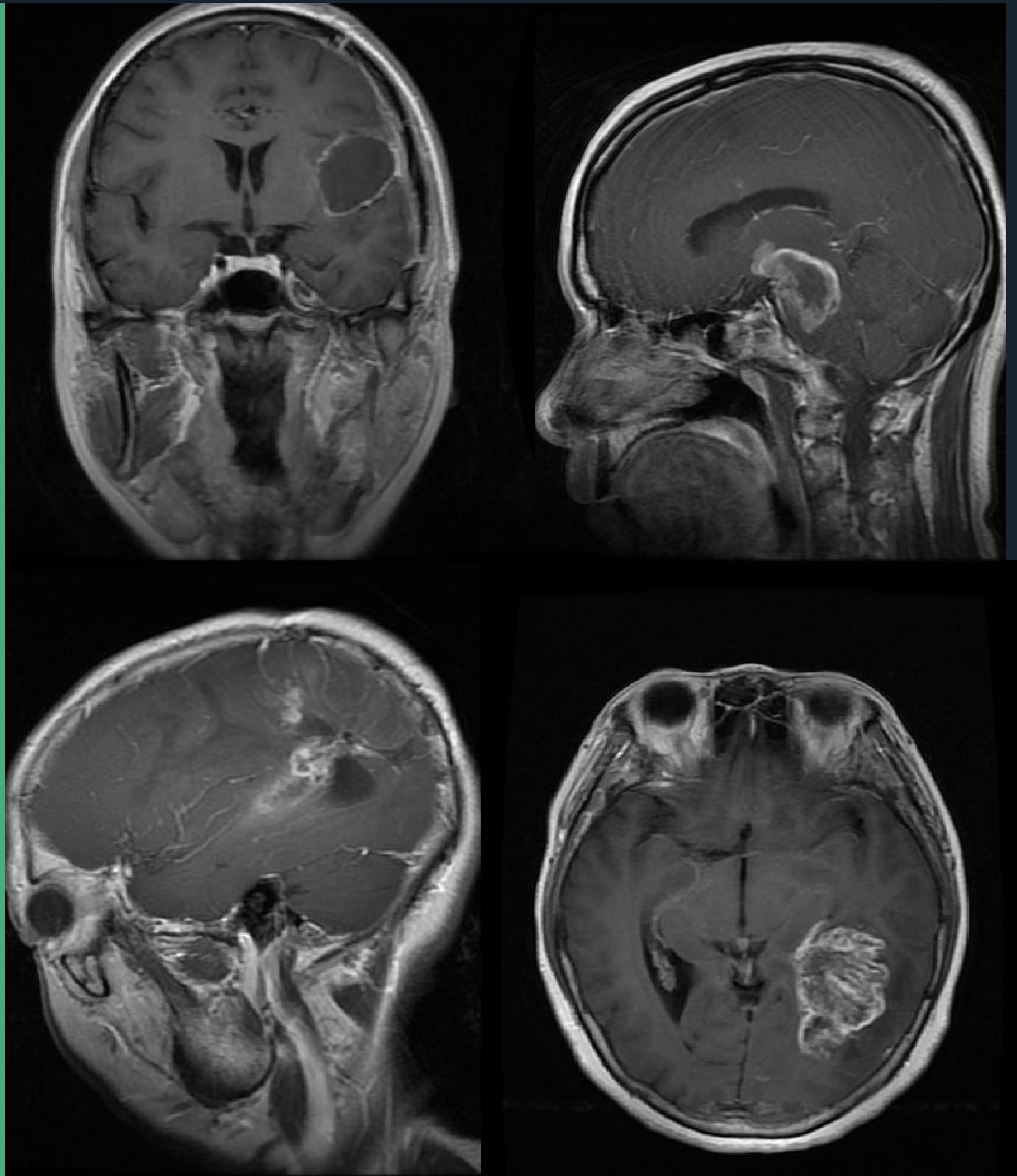


Transfer Learning

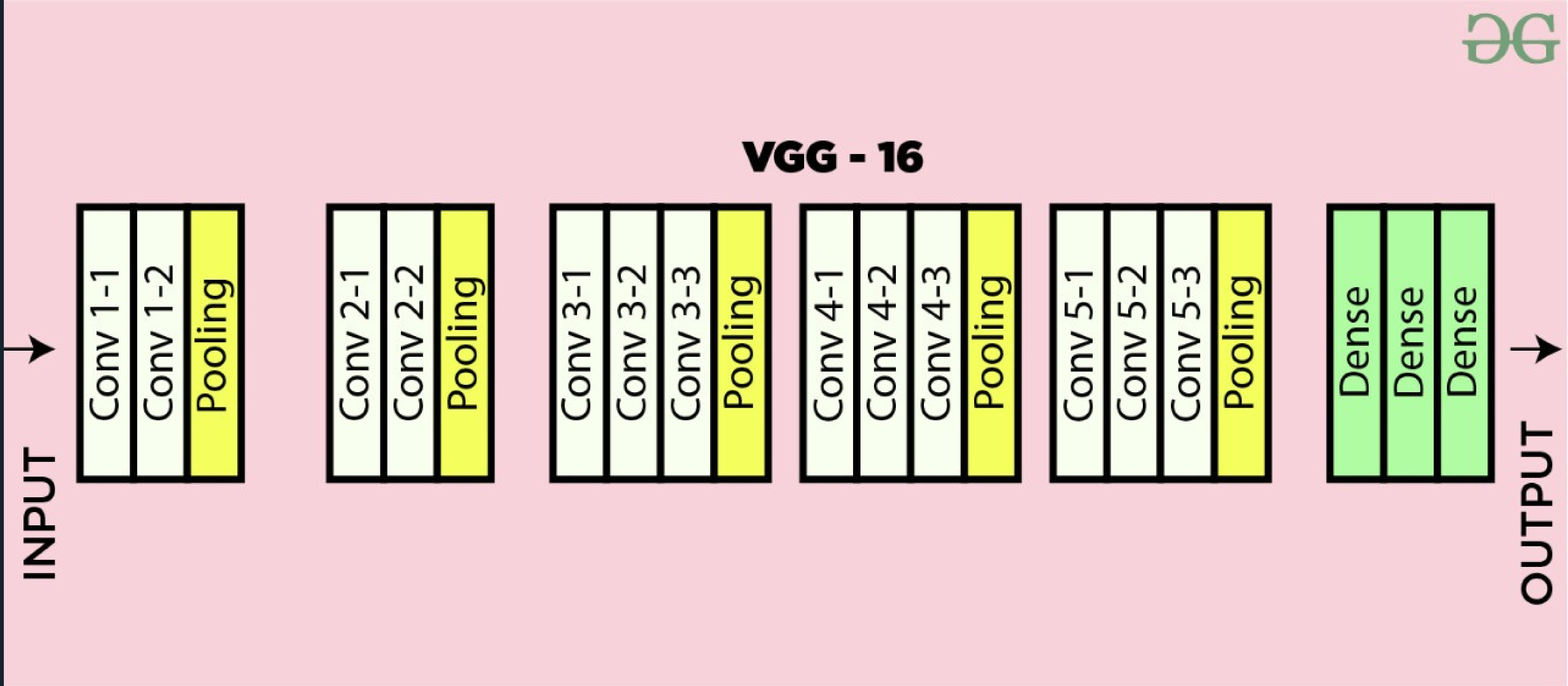
Transfer Learning is when the weights from a previously trained network is used for a different application by just retraining the last fully connected layer with a different output and activation function.



Source: GeeksForGeeks



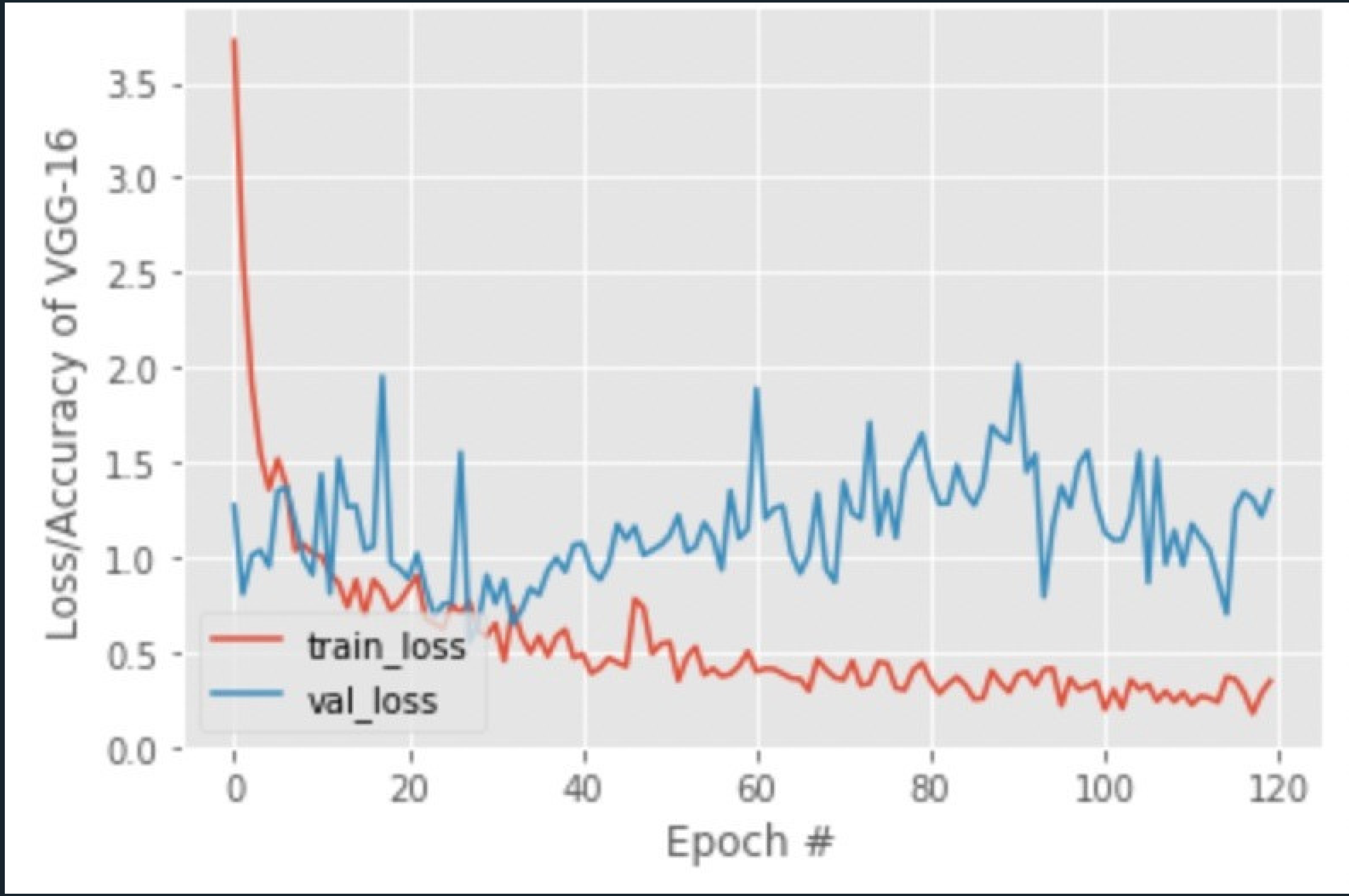
VGG16



Source: GeeksForGeeks

Loss

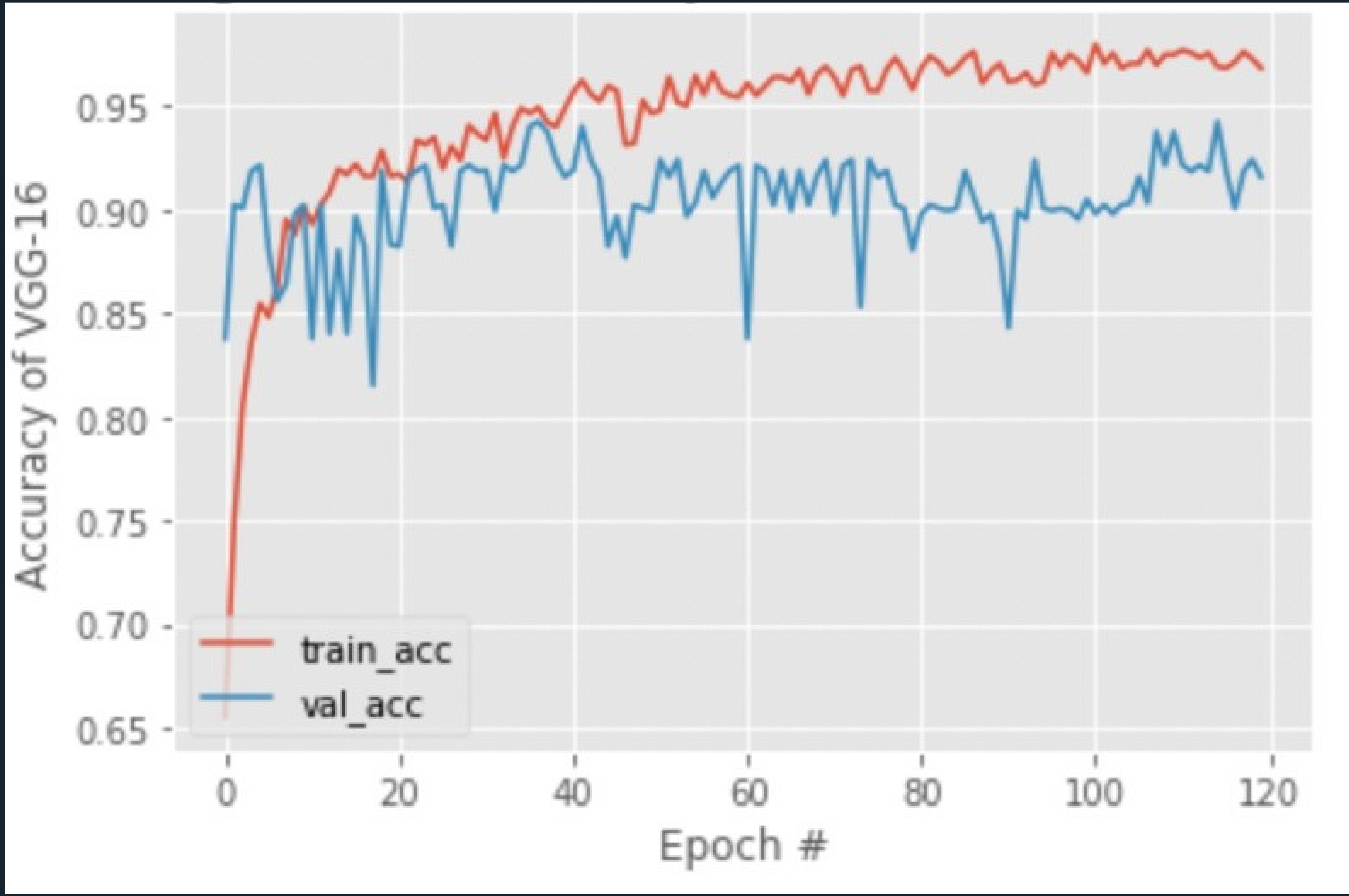
VGG16



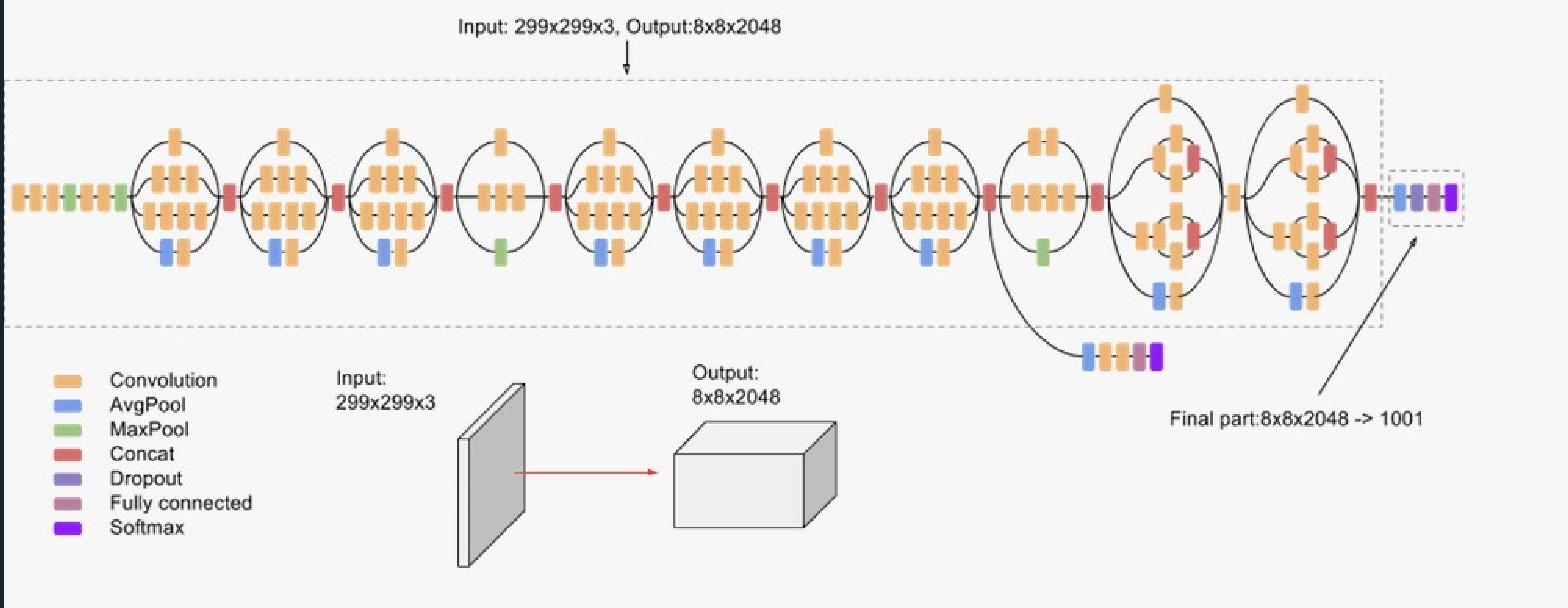
Loss/Accuracy of VGG-16
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
20
40
60
80
100
120
Epoch #
train_loss
val_loss

Accuracy

VGG16



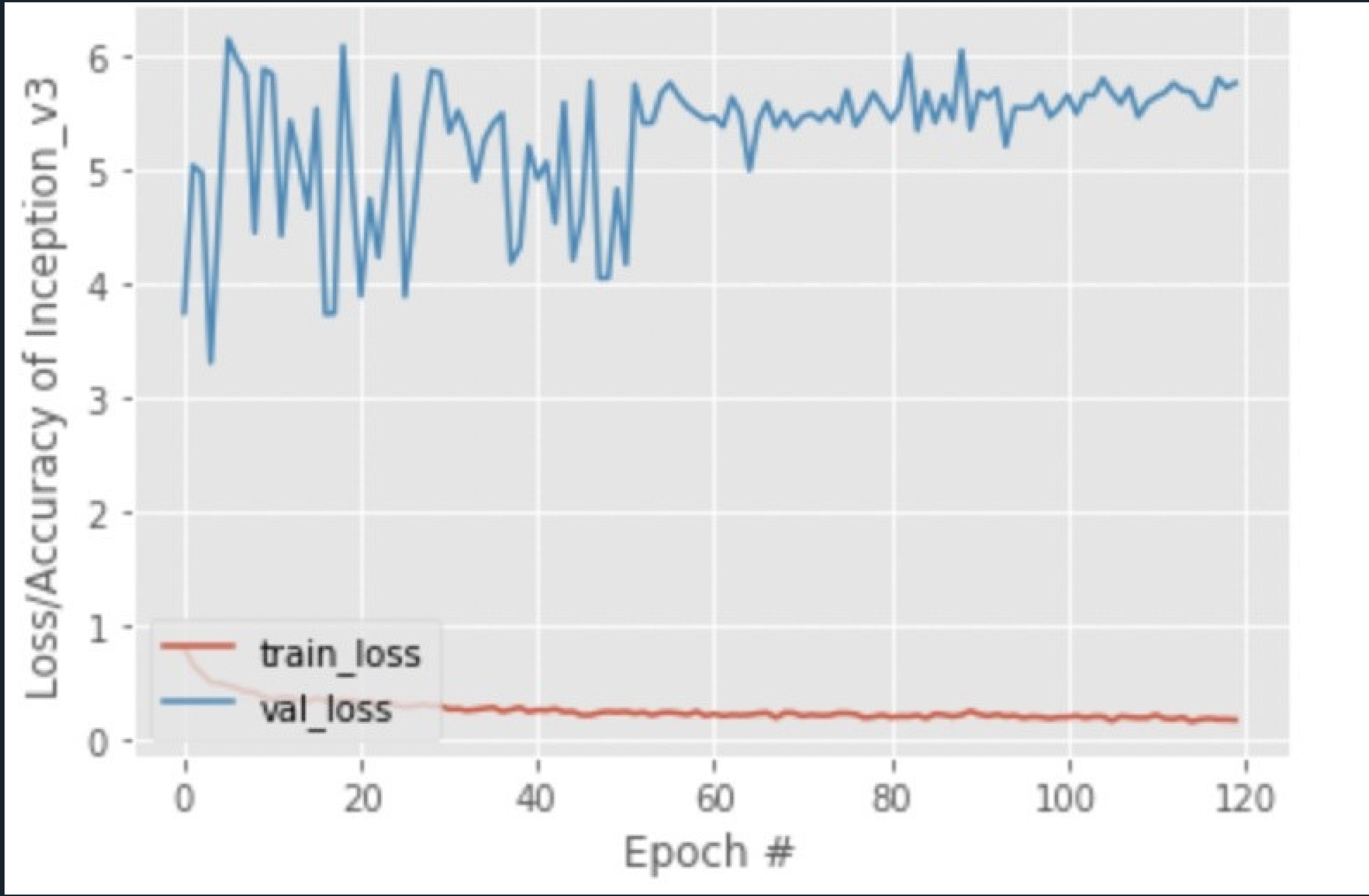
InceptionV3



Source: GeeksForGeeks

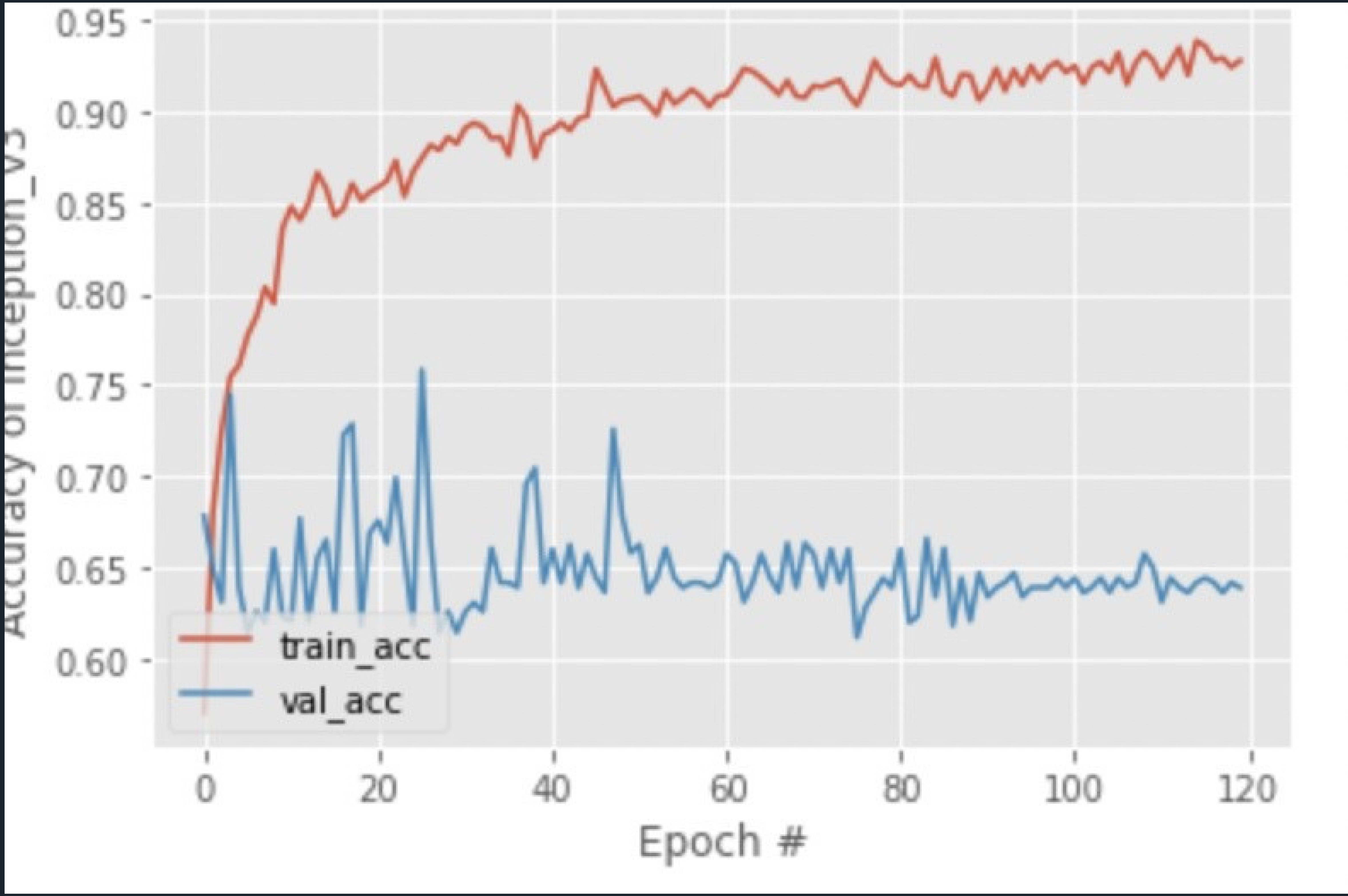
Loss

InceptionV3



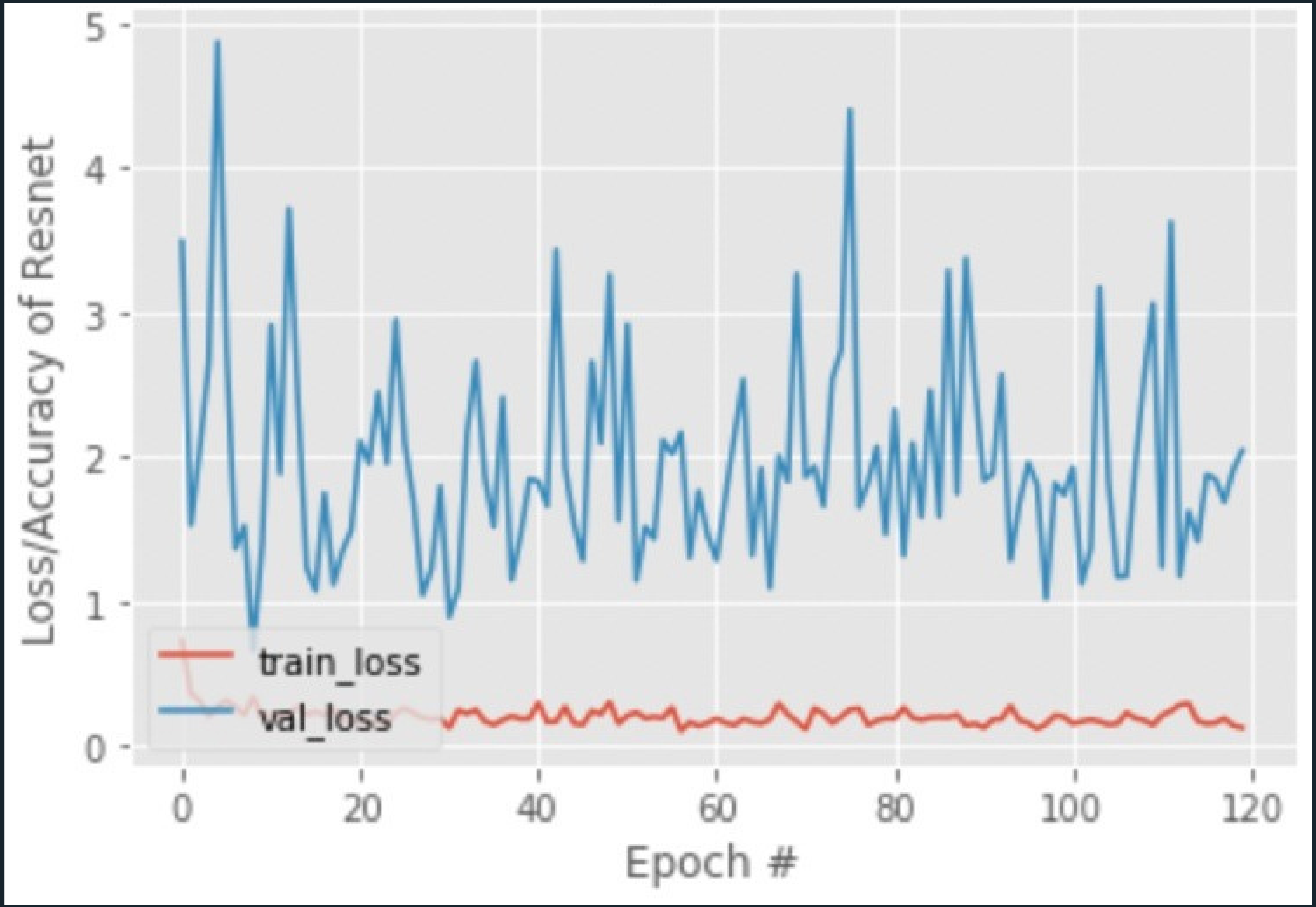
Accuracy

InceptionV3



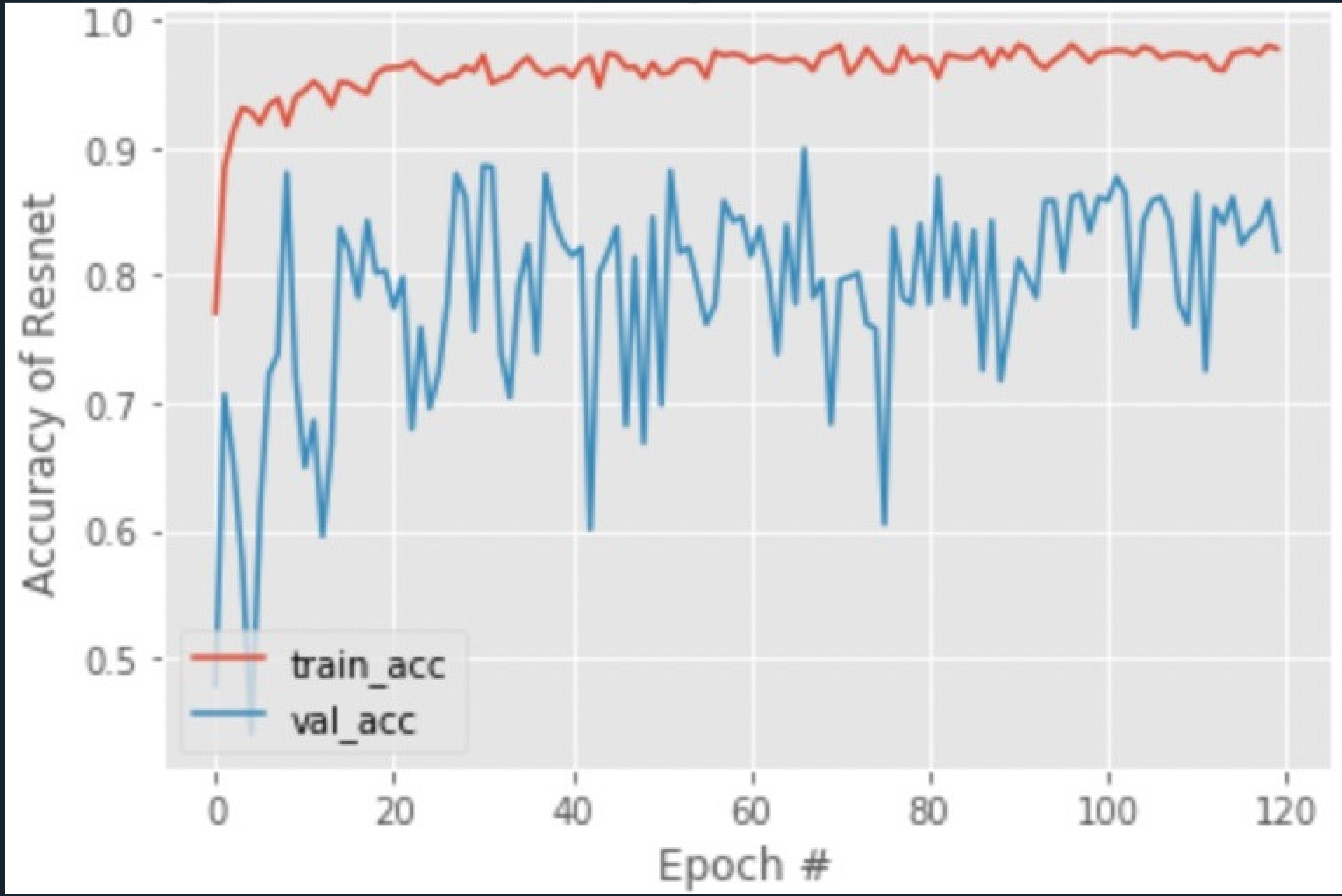
Loss

Resnet 50



Accuracy

Resnet 50



Conclusion

- Though all the models had similar accuracies, the VGG16 model performed the best
- The validation accuracy and test accuracy is higher than the other method.
- Time of computation and computation power is required lesser than traditional method as pretrained weights are used.