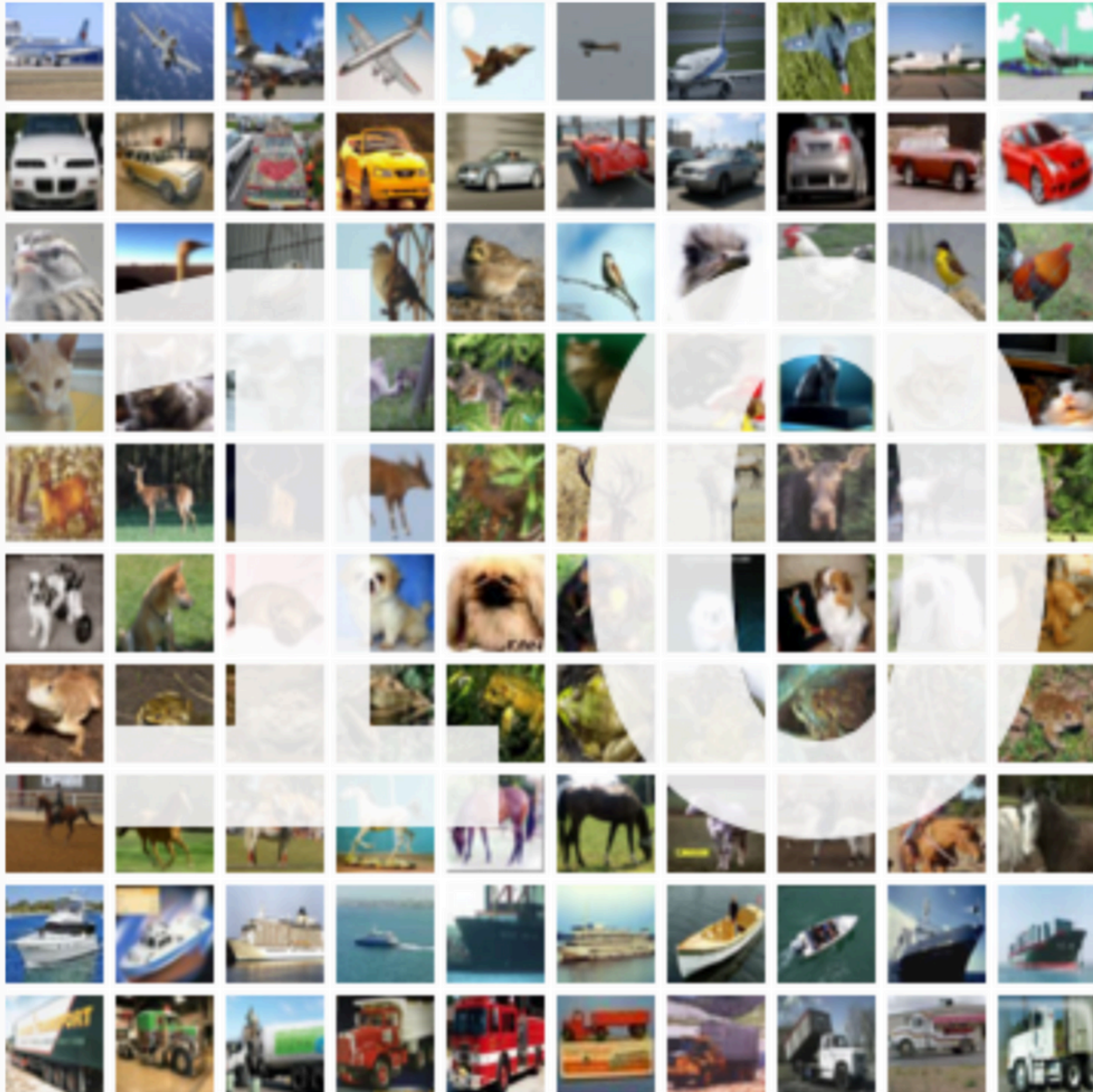


GUARDIANS OF THE GALAXY

TEAM MEMBERS:

KEBERTH
DIOGO
ELOISA

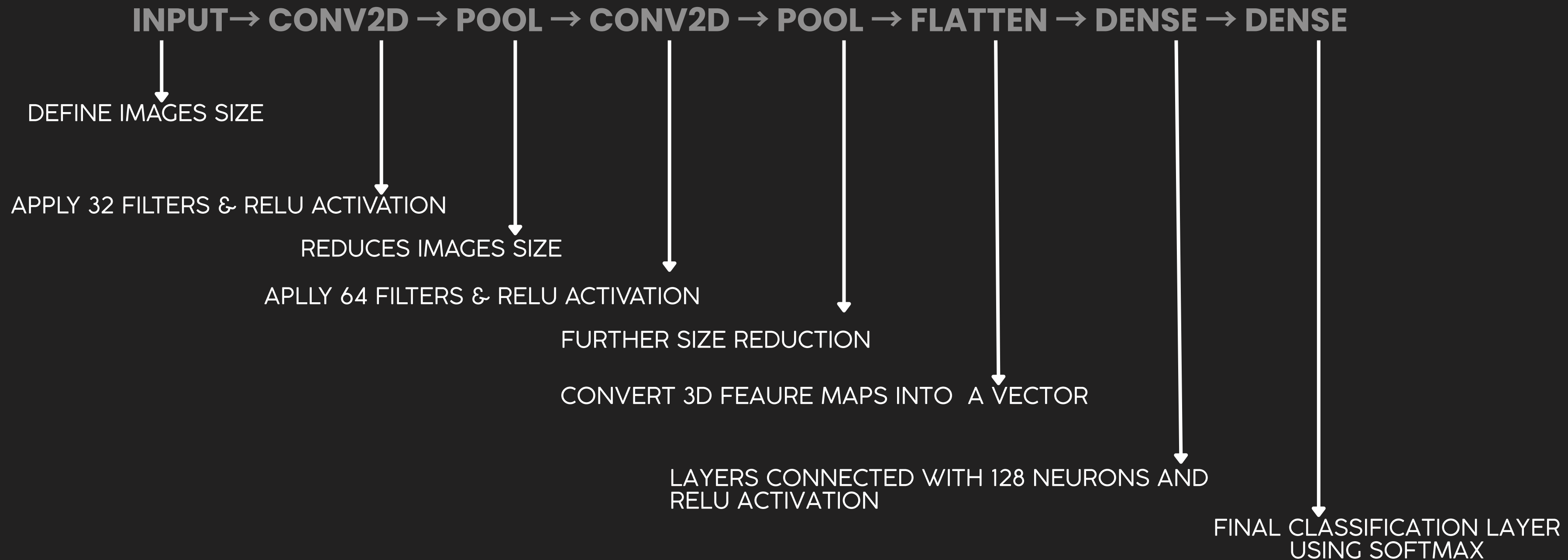


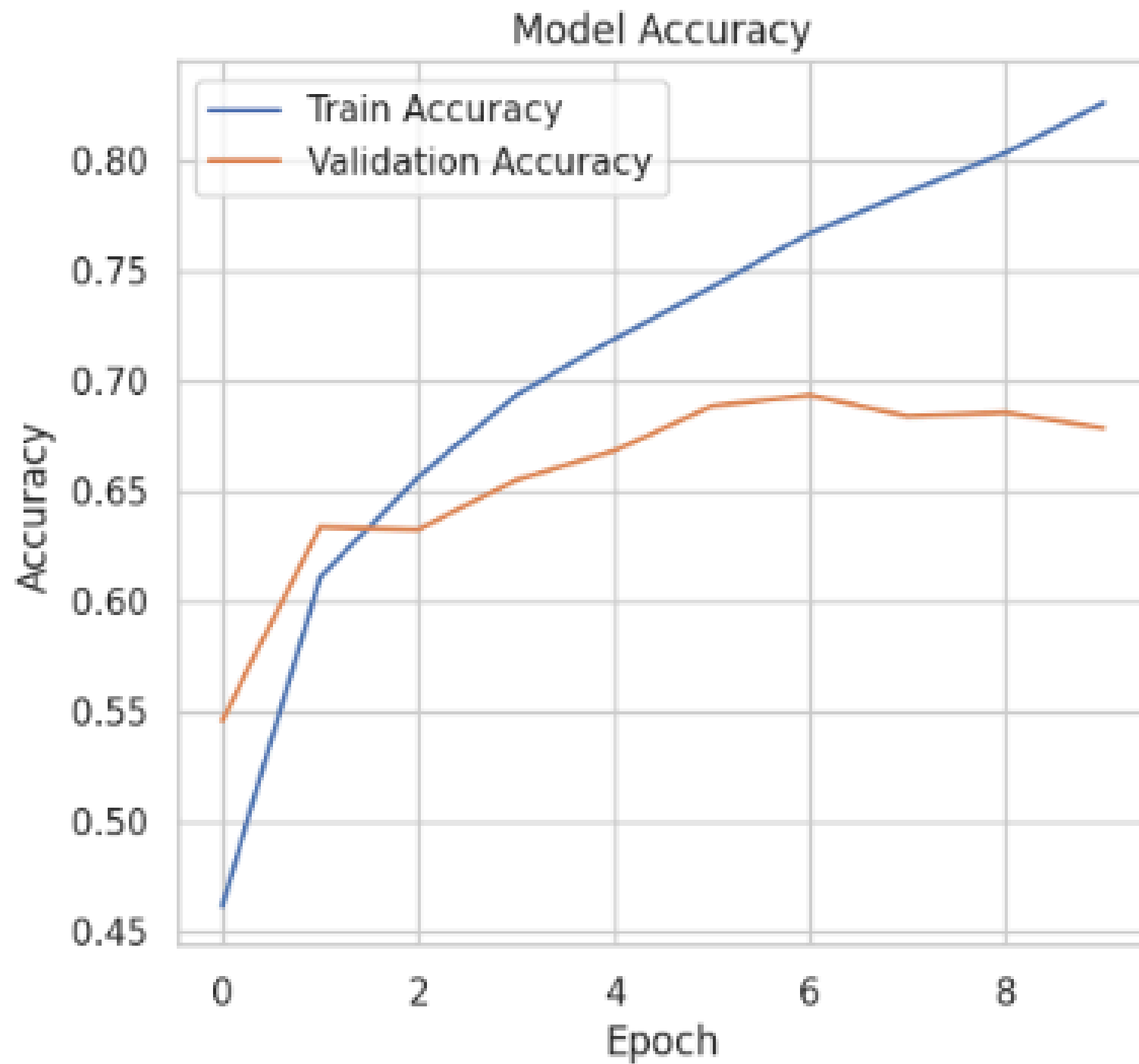
INTRODUCTION

Project Description

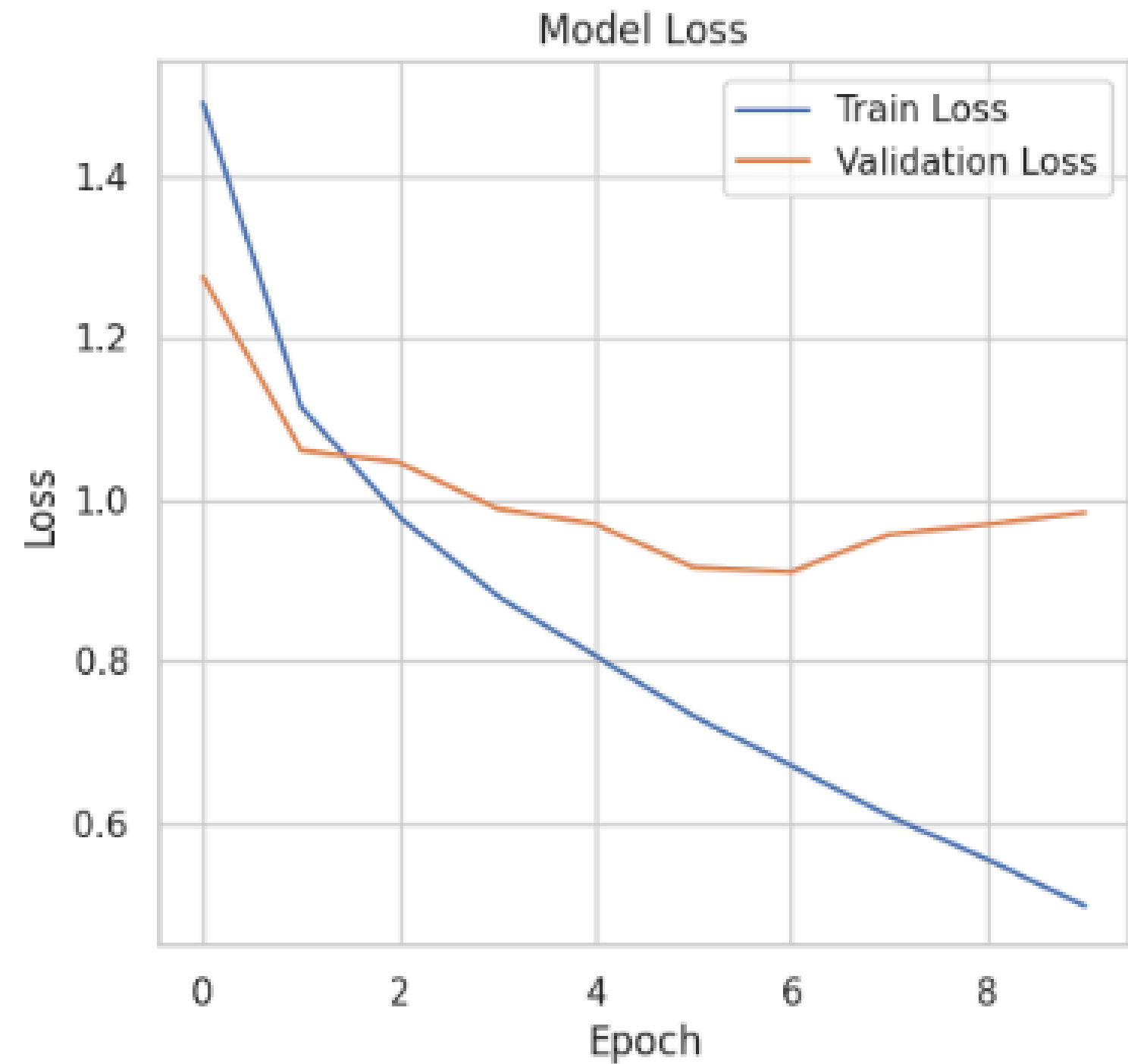
- Build a Convolutional Neural Network (CNN) model from scratch to classify images from a given dataset into predefined categories.
- Run the model without using any transfer learning approach.
- Then, implement different transfer learning approach using a pre-trained model.
- Finally, compare the performance of the custom CNN and the transfer learning model based on evaluation metrics and analysis.

CNN ARCHITECTURE



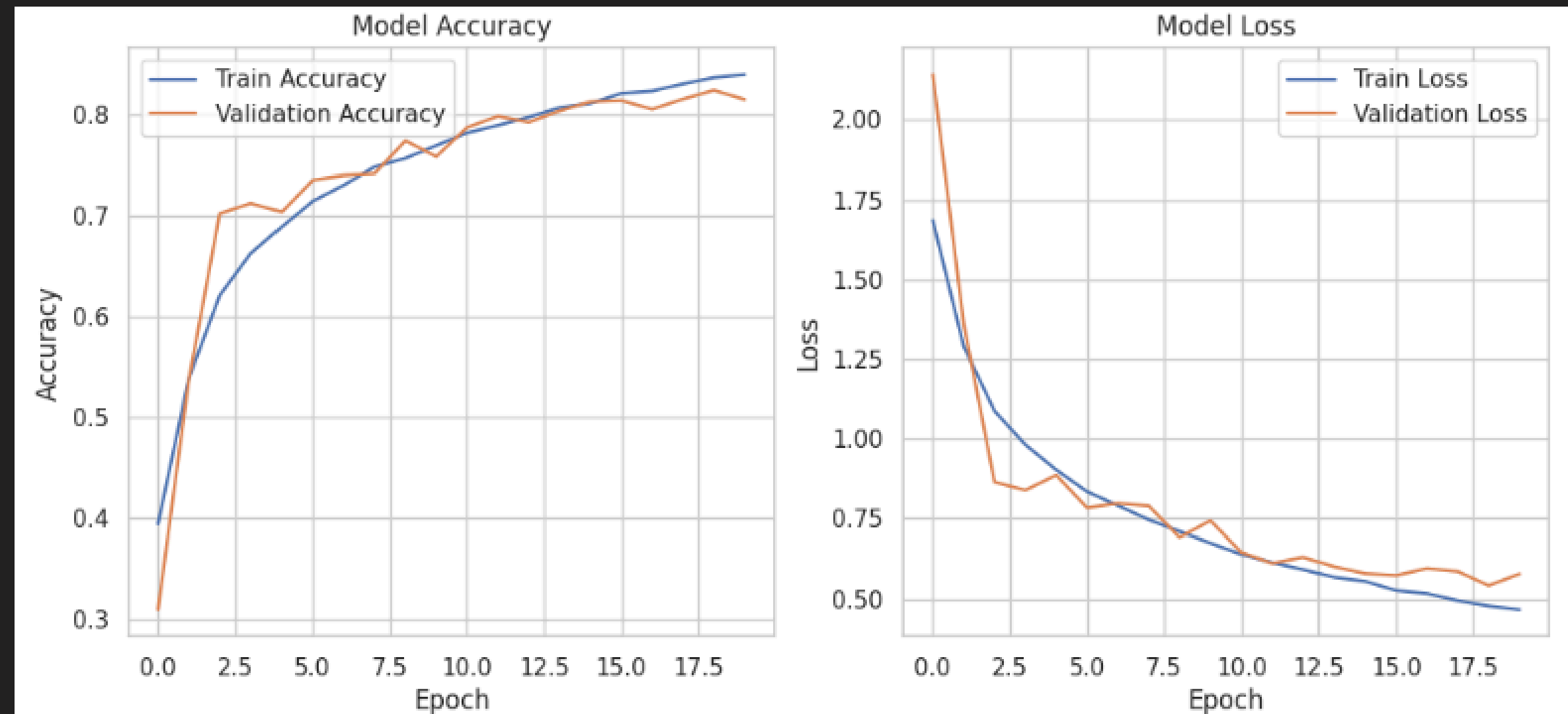
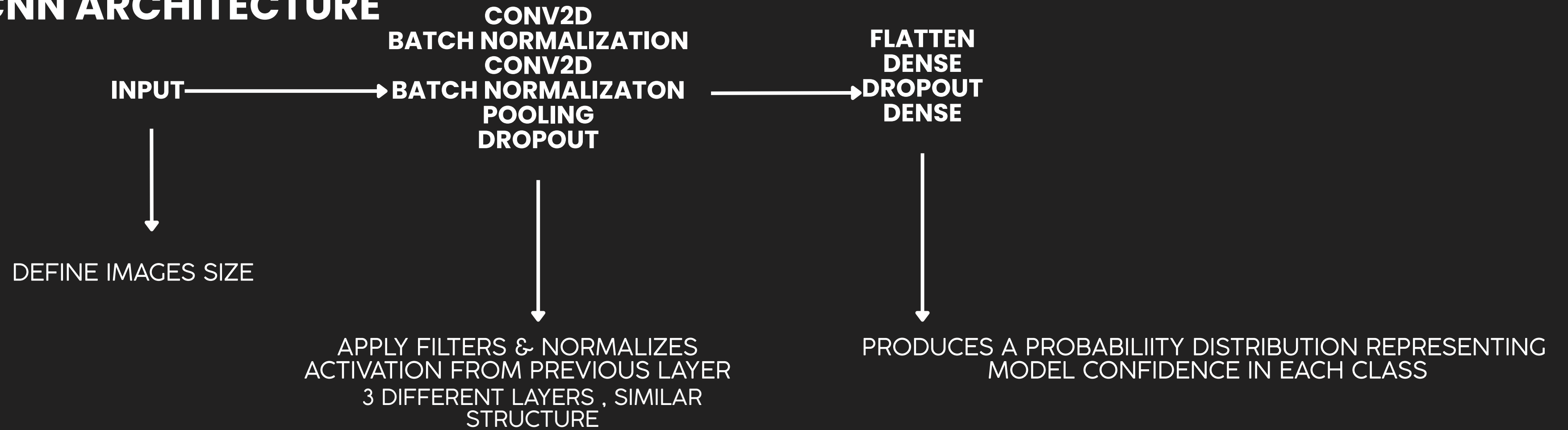


MODEL POTENTIALY MIGHT BE STARTING TO OVERFIT THE TRAINING DATA



ANOTHER SIGN OF POSSIBLE OVERFITTING IS VALIDATION LOSS STOPS DECREASING AS QUICKLY AS THE TRAINING LOSS

CNN ARCHITECTURE



TRANSFER LEARNING

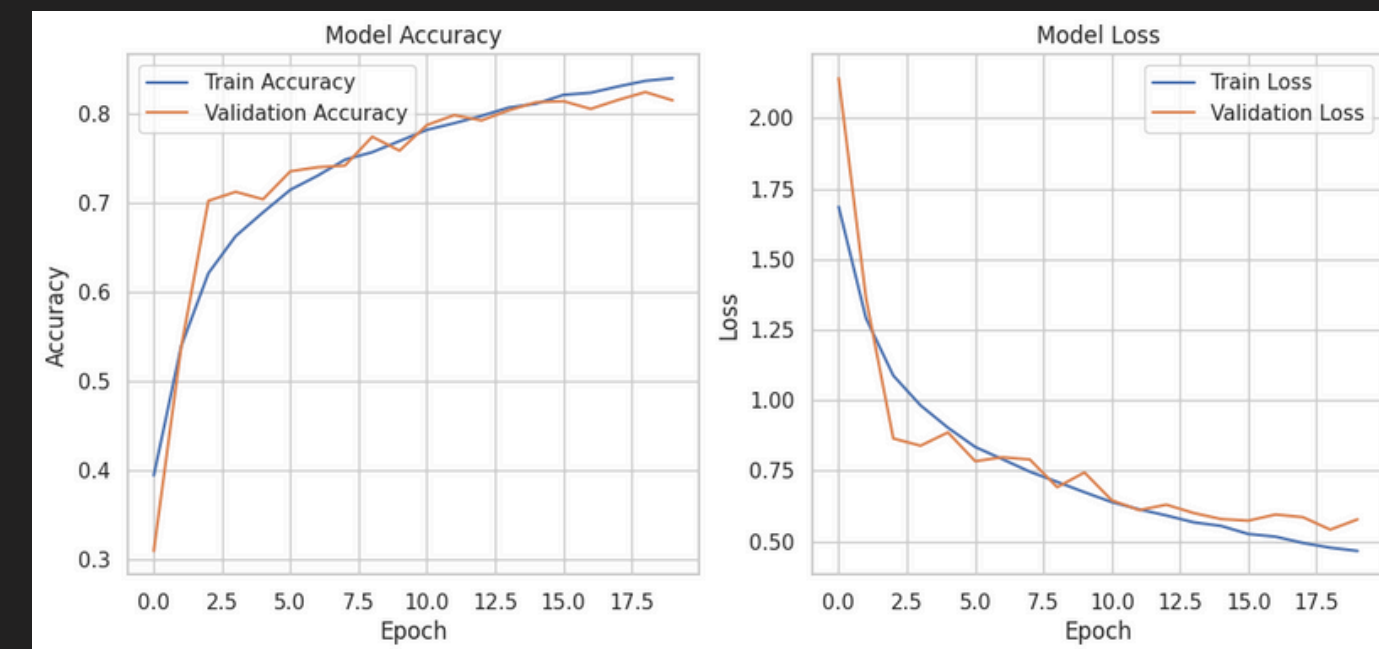
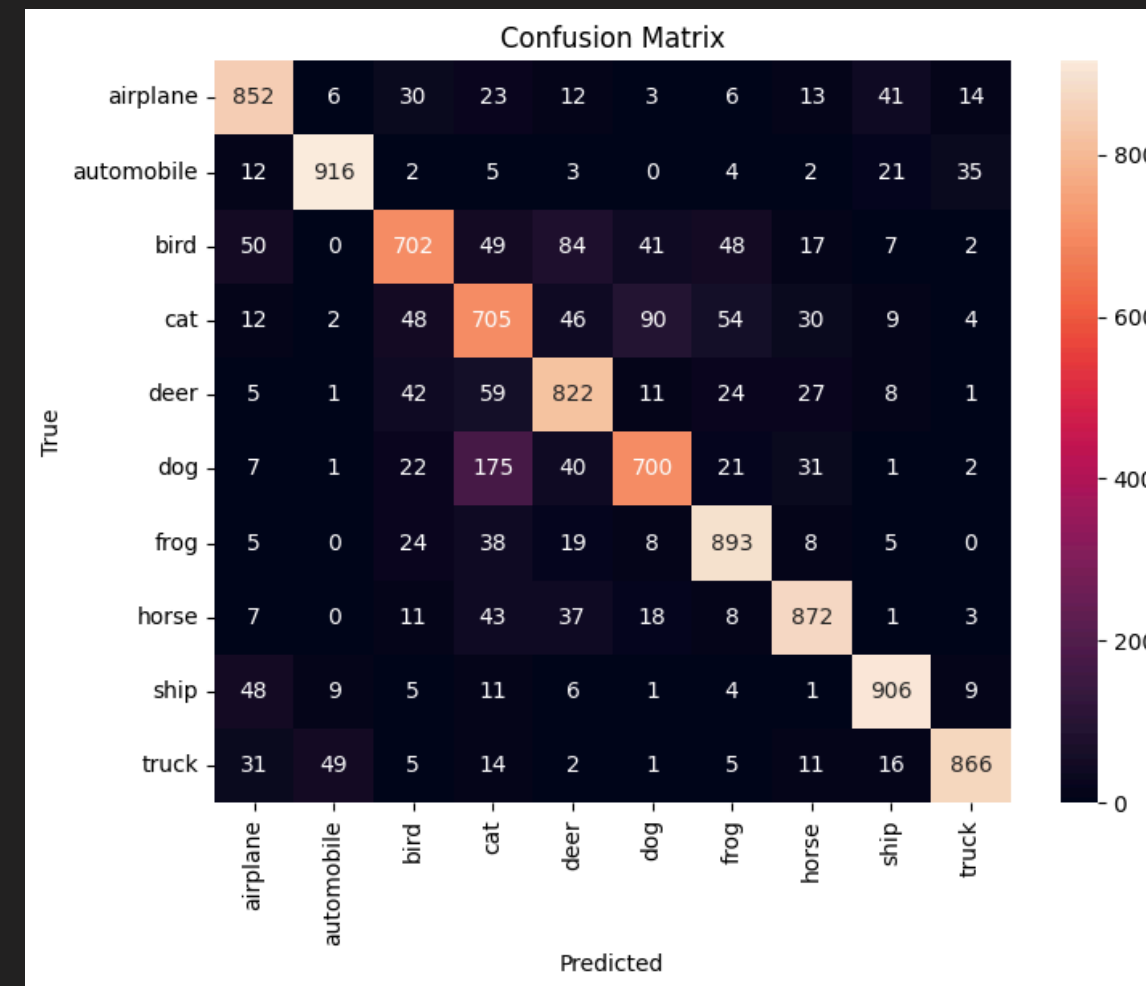
- MODELS REVIEWED, MODELS TESTED, AND FINAL SELECTION
- MODEL PRESET
- ANALYSIS VERSUS CNN MODELS
- OBSERVATIONS

MODELS

- BASIC MODELS
- MODEL TURNING - CUSTOMISED CNN
- MODEL EFFICIENTNETB2
- MODEL EFFICIENTNETB4

MODEL TUNING – CUSTOMISED CNN

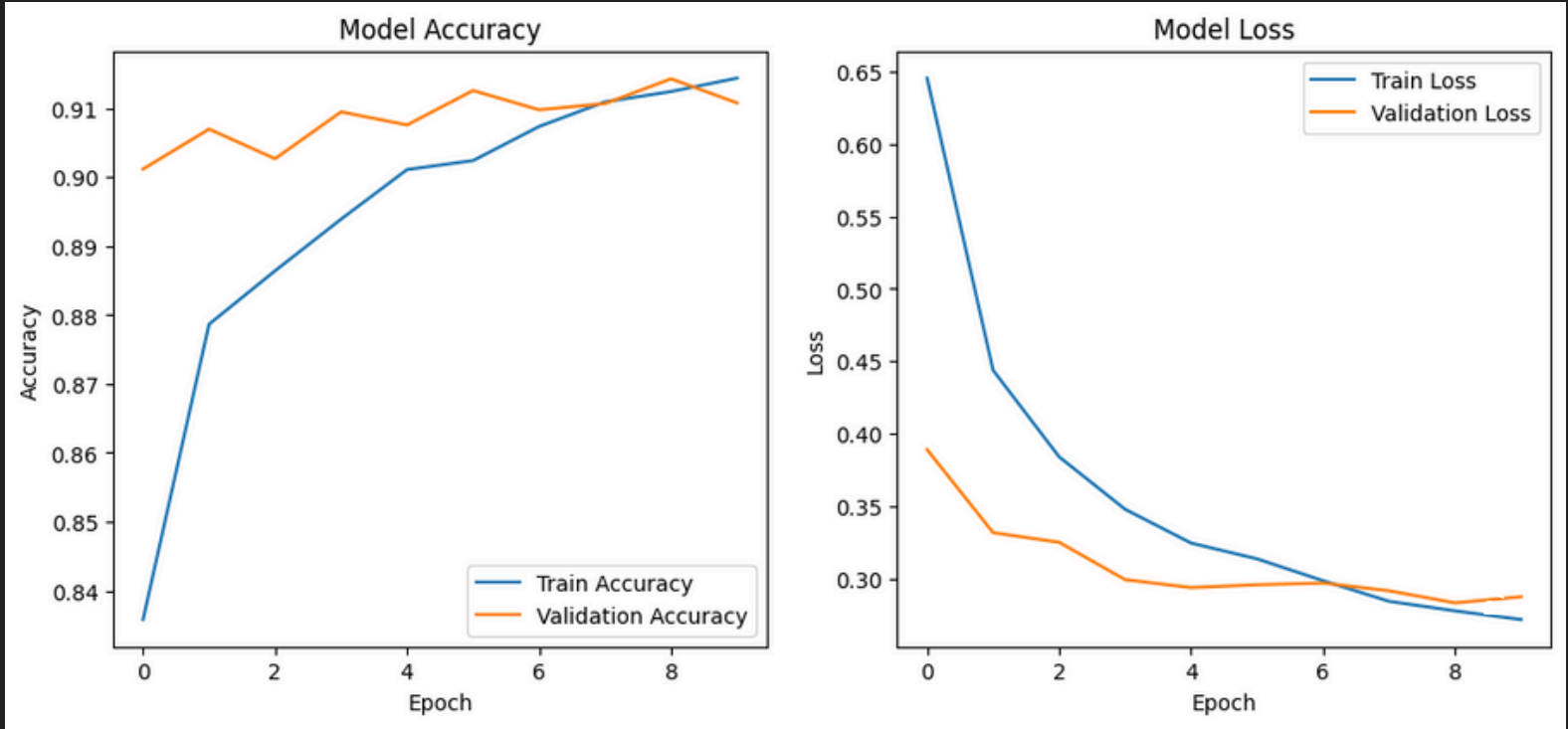
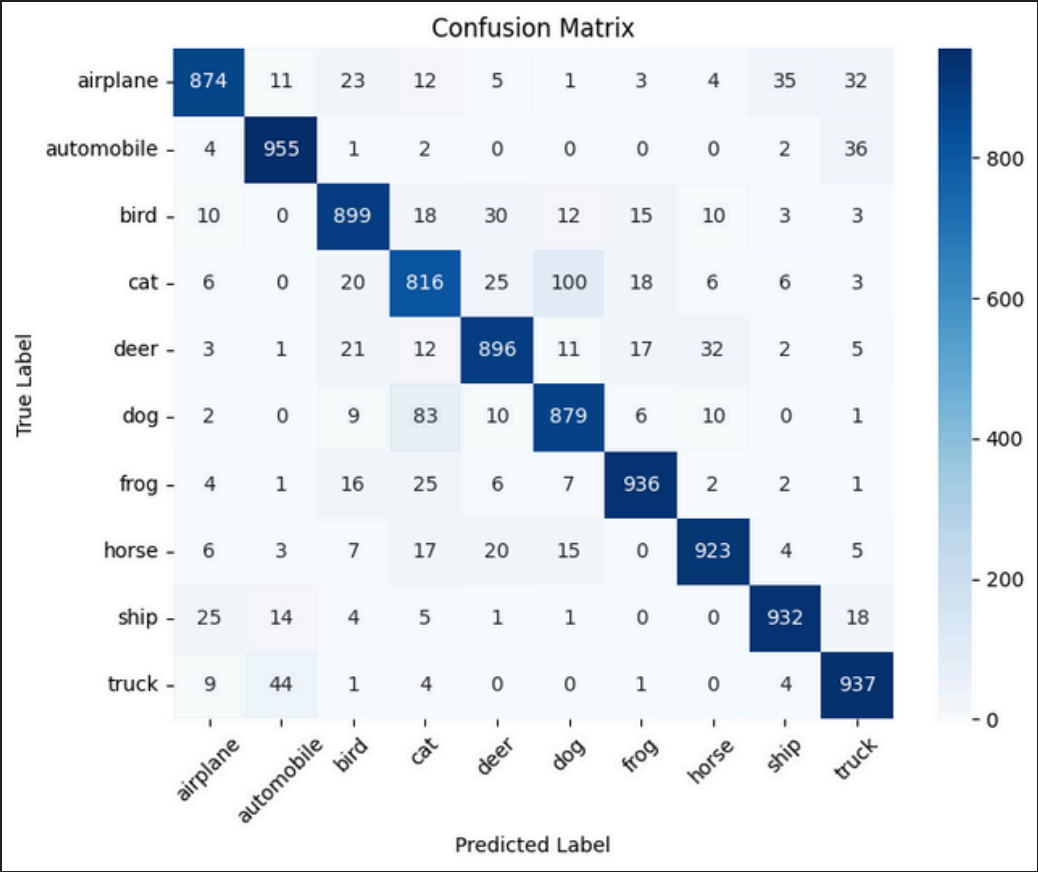
	precision	recall	f1-score	support
airplane	0.86	0.80	0.83	1000
automobile	0.95	0.87	0.91	1000
bird	0.76	0.72	0.74	1000
cat	0.70	0.61	0.65	1000
deer	0.78	0.85	0.81	1000
dog	0.75	0.74	0.74	1000
frog	0.86	0.89	0.87	1000
horse	0.83	0.87	0.85	1000
ship	0.84	0.93	0.88	1000
truck	0.86	0.92	0.89	1000
accuracy			0.82	10000
macro avg	0.82	0.82	0.82	10000
weighted avg	0.82	0.82	0.82	10000



- **TRAINING:** UP TO 20 EPOCHS, WITH 20% OF THE TRAINING DATA USED FOR VALIDATION
- **GOAL:** PREVENT OVERFITTING AND ENSURE THE VERSION OF THE MODEL
- **OVERALL ACCURACY:** ~82,00%, WITH AN AVERAGE F1 SCORE OF 0.82.
- THE MODEL LEARNS QUICKLY WITH ONLY A FEW EPOCHS
- TRAIN ACCURACY AND VALIDATION ACCURACY ARE VERY CLOSE, SHOWING THAT THE MODEL IS WELL TRAINED.

MODEL EFFICIENTNETB2

	precision	recall	f1-score	support
airplane	0.93	0.87	0.90	1000
automobile	0.93	0.95	0.94	1000
bird	0.90	0.90	0.90	1000
cat	0.82	0.82	0.82	1000
deer	0.90	0.90	0.90	1000
dog	0.86	0.88	0.87	1000
frog	0.94	0.94	0.94	1000
horse	0.94	0.92	0.93	1000
ship	0.94	0.93	0.94	1000
truck	0.90	0.94	0.92	1000
accuracy			0.90	10000
macro avg	0.90	0.90	0.90	10000
weighted avg	0.90	0.90	0.90	10000



- I RESHAPE TO 128X128PX AND IT IMPROVES THE PERFORMANCE ON $\pm 20\%$ ACCURACY.

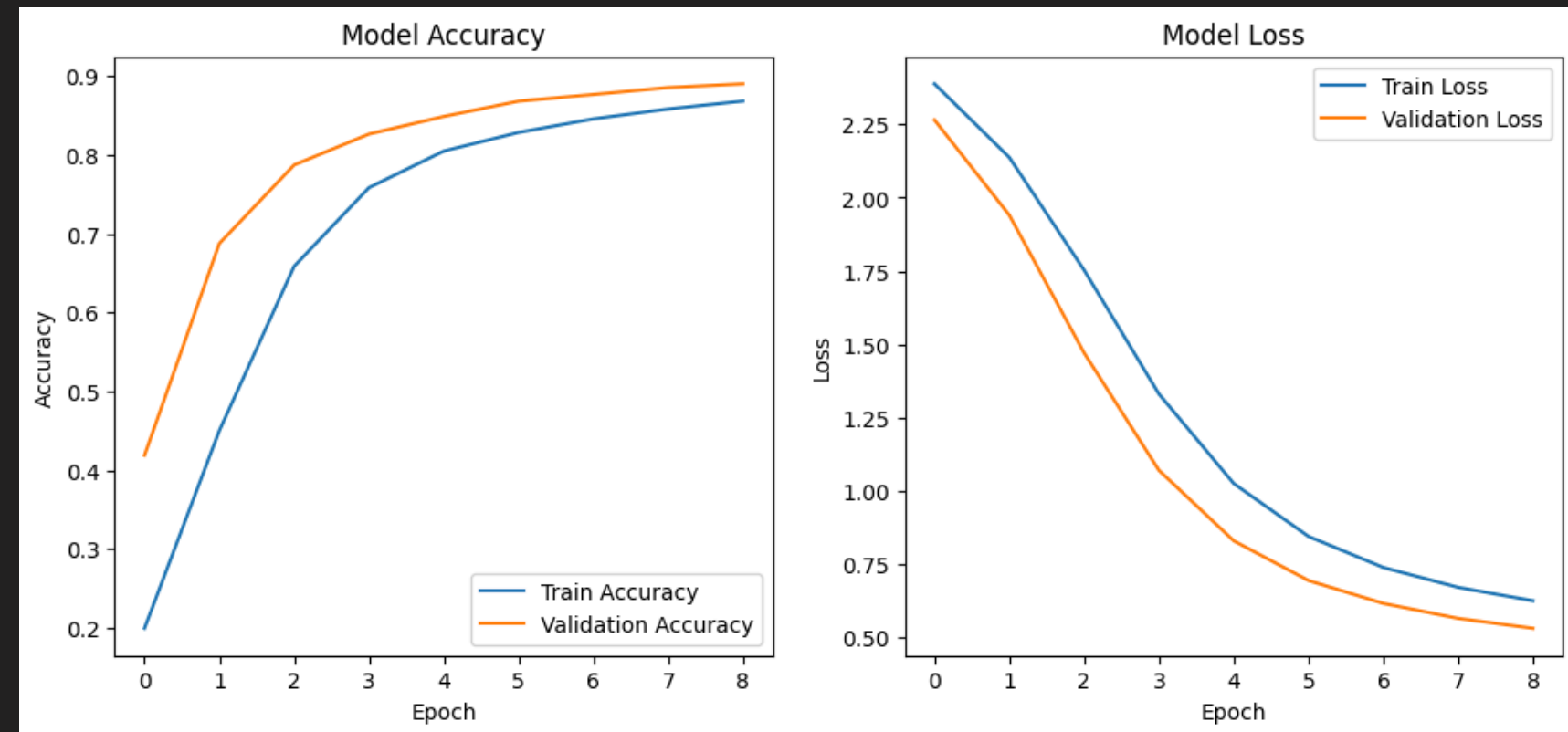
TRAINING AND VALIDATION ACCURACY ANALYSIS:

- THE TRAINING ACCURACY INCREASES CONTINUOUSLY FROM APPROXIMATELY 0.84 \rightarrow 0.92, INDICATING THAT THE MODEL IS LEARNING CONSISTENTLY.
- THE VALIDATION ACCURACY STARTS AT AROUND 0.90, SHOWS SLIGHT OSCILLATIONS, AND ENDS AT APPROXIMATELY 0.91.

MODEL EFFICIENTNETB4

- WE ARE GONNA USE THE SAME PRESET SETTINGS AS B2 FOR B4 (TUNED) AND COMPARE IT RESULTS

	precision	recall	f1-score	support
airplane	0.90	0.90	0.90	1000
automobile	0.94	0.95	0.94	1000
bird	0.90	0.85	0.88	1000
cat	0.79	0.75	0.77	1000
deer	0.88	0.87	0.88	1000
dog	0.83	0.84	0.84	1000
frog	0.86	0.93	0.89	1000
horse	0.94	0.92	0.93	1000
ship	0.92	0.95	0.94	1000
truck	0.92	0.93	0.92	1000
accuracy			0.89	10000
macro avg	0.89	0.89	0.89	10000
weighted avg	0.89	0.89	0.89	10000



Accuracy:

- Train accuracy increases from ~0.20 to ~0.87
- Validation accuracy increases from ~0.42 to ~0.89

Loss:

- Training and validation loss decrease in a healthy way
- No spikes, no divergence → the model is learning properly

DATA PREPROCESSING

FOR EFFICIENTNETB2

DYPES

PARAMS: **9.2M**

HEIGHT

DEPTH: **186**

WEIGHT

TOP 1% **80.1%**

CHANNELS

TOP 5%: **94.9%**

ADJUSTING THE MODEL

Custom Top Classifier

Model compilation

1. **BASE MODEL** (160)
2. **GLOBALAVERAGEPOOLING2D**
3. **DENSE** (128) USING **RELU**
4. **DROPOUT** 20%
5. **DENSE** (256) USING **RELU**
6. **KERNEL REGULARIZATION** L2 (0.001)
7. **DENSE** (10) USING **SOFTMAX**

- **OPTIMIZER** ADAM
- **LEARNING RATE** (5e-6)
- **CATEGORICAL CROSSENTROPY**
- **ACCURACY** METRICS

CALLBACKS

Reduce LR On Plateau

Reduces Learning Rate on plateau by the factor to help fine learning by the model

- **MONITOR** VAL LOSS
- **FACTOR** 50%
- **PATIENCE** 2 EPOCHS
- **MINMUM LR** 1E-8

Early Stopping

Stops early the model training when there is no improvement on the patience defined epochs

- **MONITOR** VAL LOSS
- **BEST WEIGHTS** TRUE
- **PATIENCE** 3 EPOCHS
- **MINIMUM DELTA** 1E-5

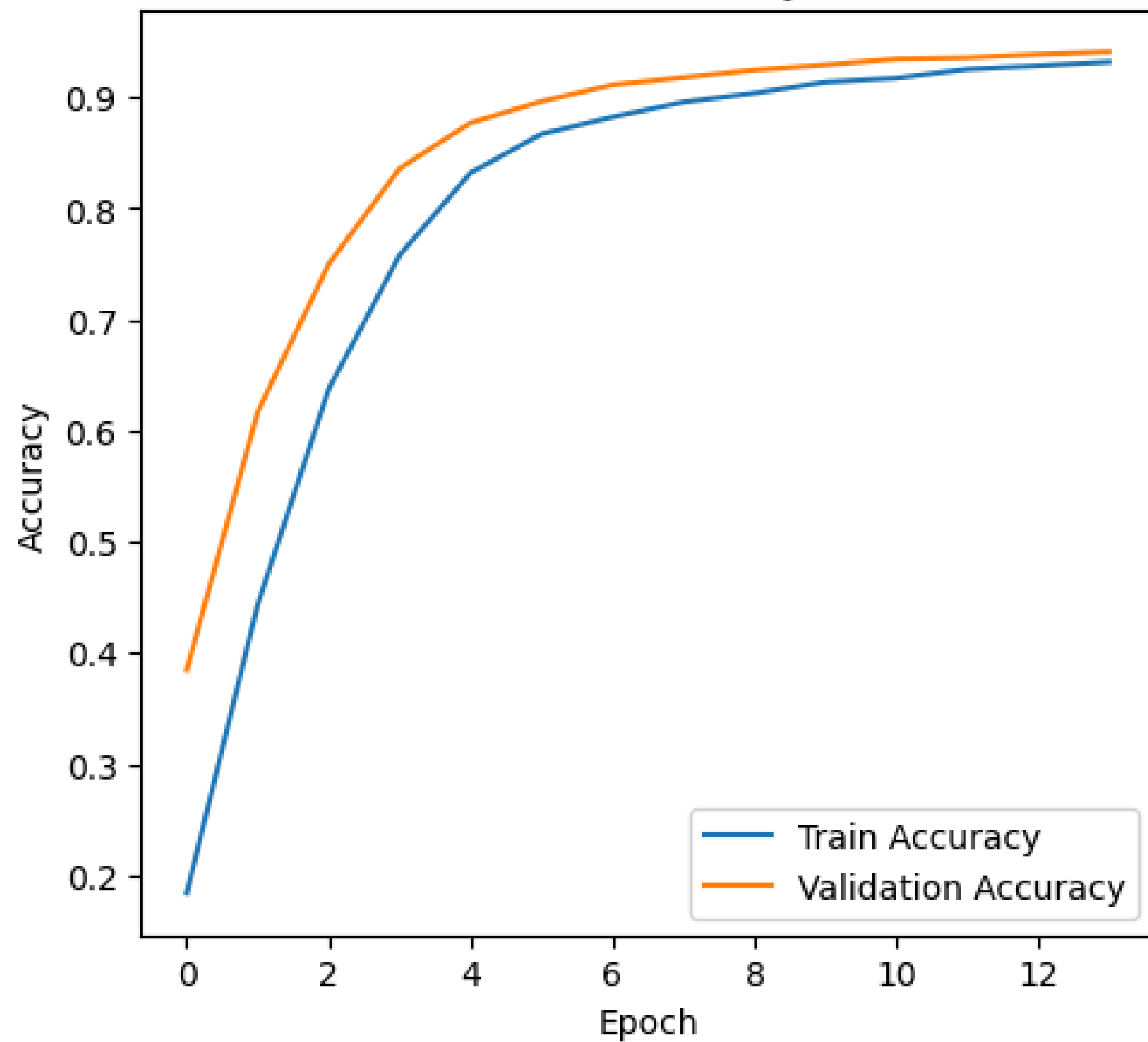
MODEL FIT

History Fine Tuned

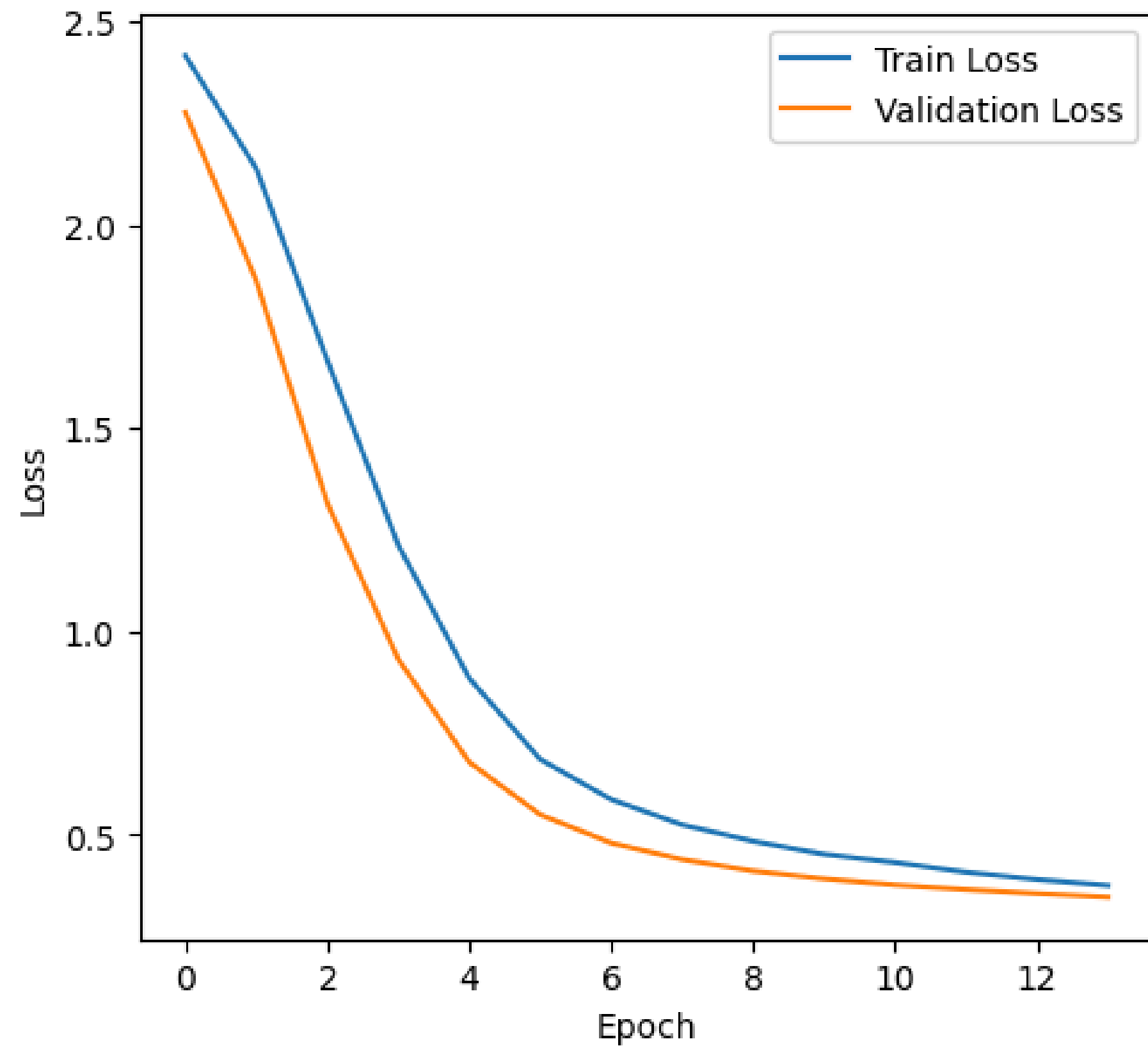
- **VALIDATION SPLIT** 20%
- **EPOCHS** 18 TOTAL EPOCHS
- **INITIAL EPOCH** 4
- **BATCH SIZE** 128 PER BATCH

airplane	0.94	0.95	0.95	1000
automobile	0.96	0.97	0.96	1000
bird	0.94	0.93	0.94	1000
cat	0.88	0.84	0.86	1000
deer	0.93	0.94	0.94	1000
dog	0.88	0.89	0.88	1000
frog	0.96	0.97	0.96	1000
horse	0.95	0.95	0.95	1000
ship	0.96	0.97	0.96	1000
truck	0.96	0.95	0.96	1000
accuracy			0.94	10000
macro avg	0.94	0.94	0.94	10000
weighted avg	0.94	0.94	0.94	10000

Model Accuracy



Model Loss



WHAT'S NEXT?

DATA AUGMENTATION

FOCAL LOSS

OTHER MODELS

THANKS

Guardians of the Galaxy