Image Classification with CNN

25-27th September, 2024

G2

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Agenda

- Dataset Chosen
- escription of the chosen CNN architecture.
- Explanation of preprocessing steps.
- Details of the training process (e.g., learning rate, batch size, number of epochs).
- Results and analysis of models performance.
- What is your best model? Why?

Insights gained from the experimentation process.

Datasets Avaliable

- CIFAR-10
- Animals-10

Datasets Chosen

- CIFAR-10

Datasets Chosen, why?

- CIFAR-10

Lighter

Standardize images sizes

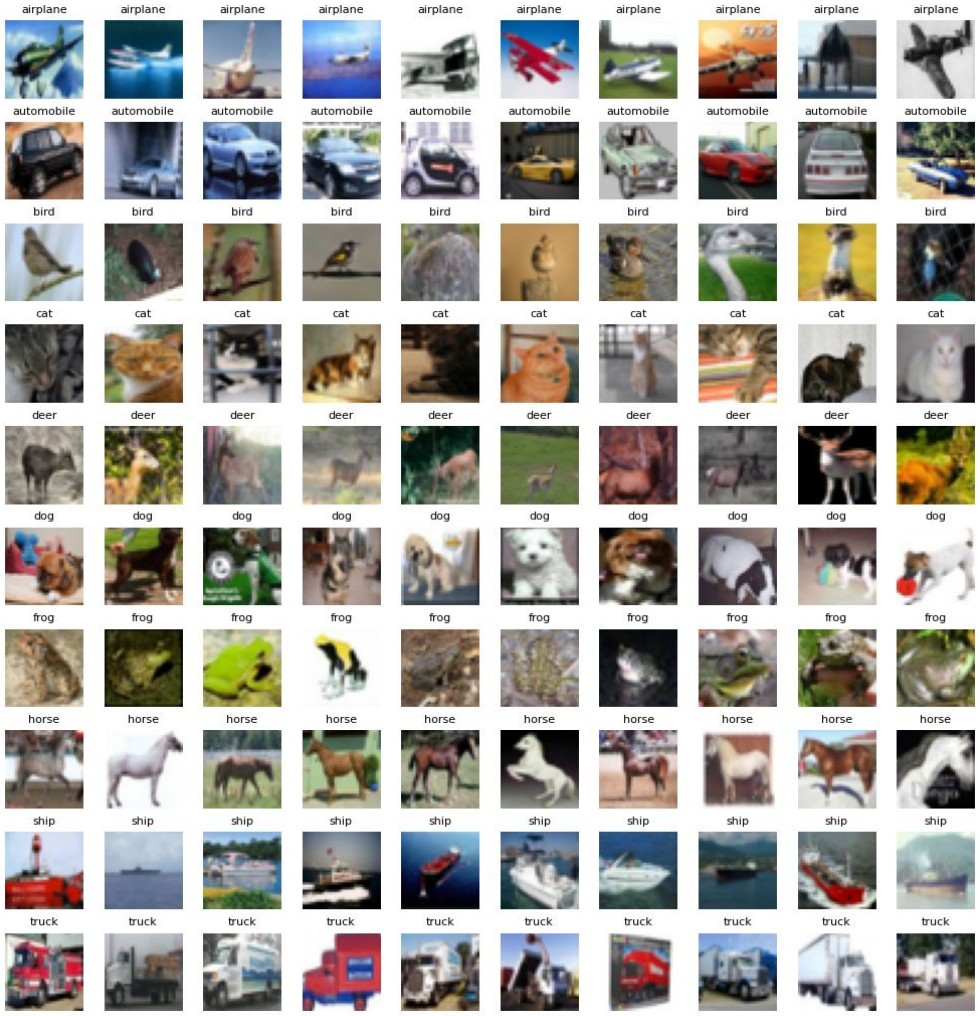
Loaded directly as NumPy array

Easy to manipulate and plot for quick reviewing

Dataset Review

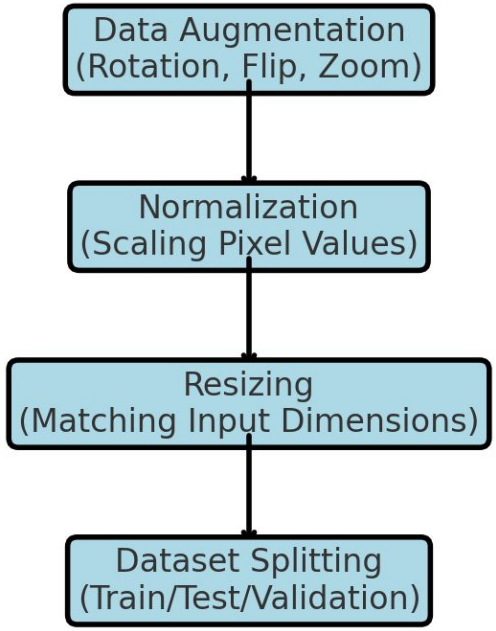
- CIFAR-10 limitations

The size could be an issue to run though too many Convolution and Max Pooling layers



Dataset Preprocessing

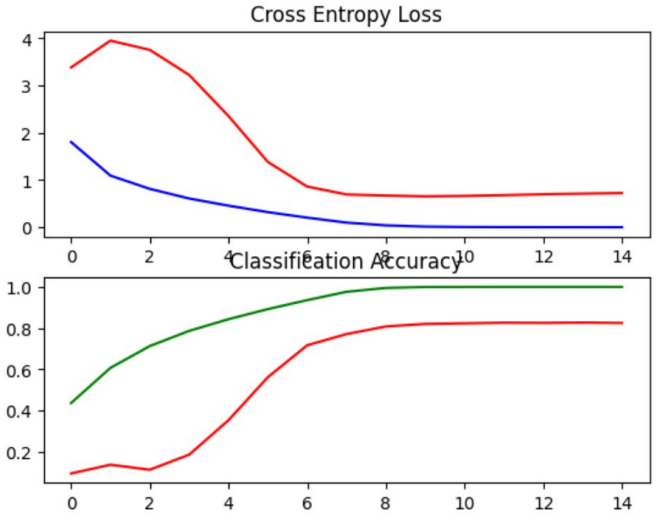
- Batch Normalisation
- Labels 1-Hot-Encoding
- Data Augmentation

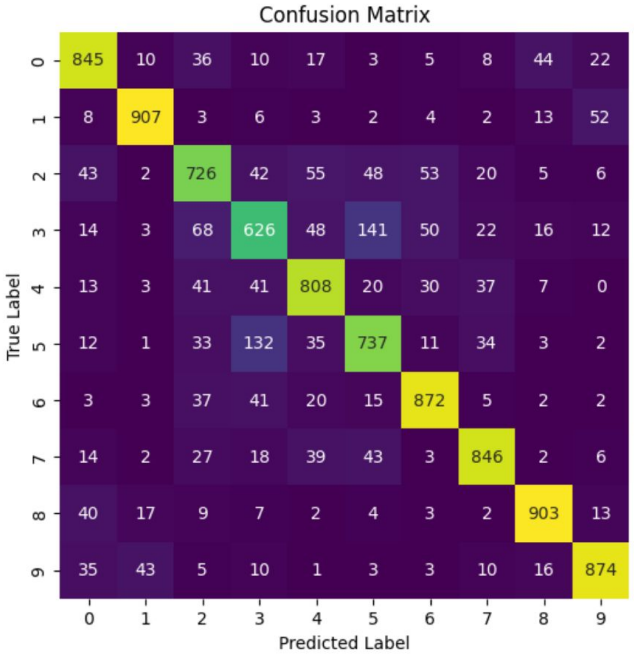


- CNN Architecture (no data augmentation)

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_6 (Conv2D)           (None, 32, 32, 64)        1792

 conv2d_7 (Conv2D)           (None, 32, 32, 64)        36928

 max_pooling2d_3 (MaxPoolin  (None, 16, 16, 64)        0
 g2D)

 conv2d_8 (Conv2D)           (None, 16, 16, 128)       73856

 conv2d_9 (Conv2D)           (None, 16, 16, 128)       147584

 max_pooling2d_4 (MaxPoolin  (None, 8, 8, 128)         0
 g2D)

 conv2d_10 (Conv2D)          (None, 8, 8, 256)         295168

 conv2d_11 (Conv2D)          (None, 8, 8, 256)         590080

 max_pooling2d_5 (MaxPoolin  (None, 4, 4, 256)         0
 g2D)

 flatten_1 (Flatten)         (None, 4096)              0

 dense_2 (Dense)             (None, 256)               1048832

 dense_3 (Dense)             (None, 10)                2570

=================================================================
Total params: 2196810 (8.38 MB)
Trainable params: 2196810 (8.38 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

- Optimizer/Loss: Adam / Cat. Crossentropy
- Epochs: 15
- Test accuracy: 0.81
- Test loss: 0.77
- F1-score and recall: 0.81



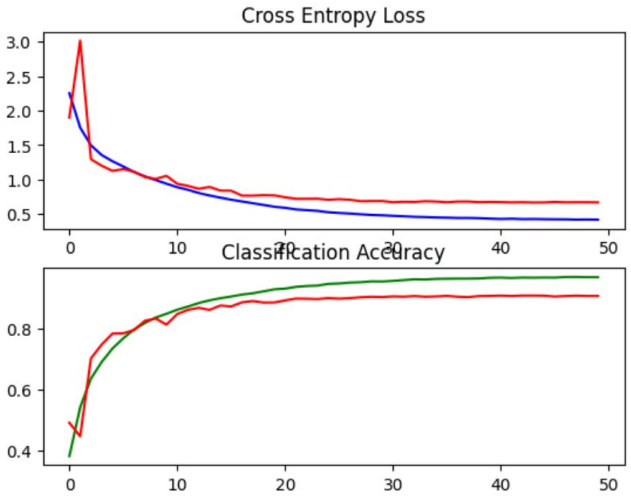


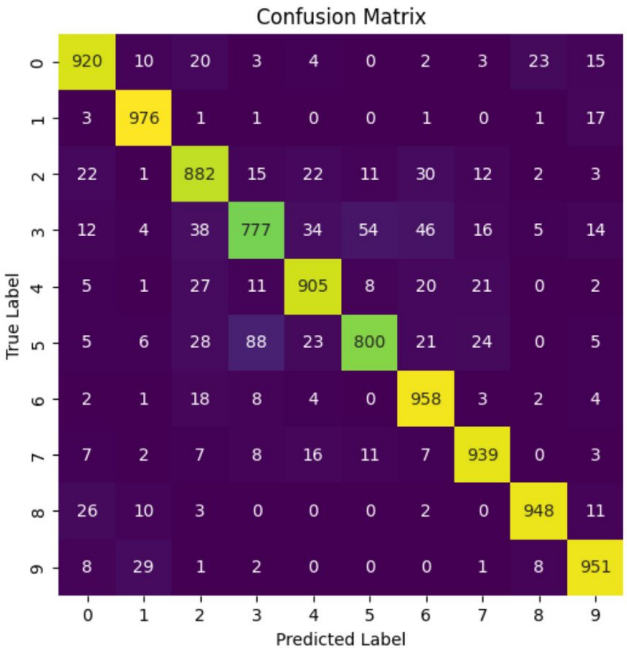
- Optimizer/Loss: Adam / Cat. Crossentropy
- Epochs: 15
- Test accuracy: 0.81
- Test loss: 0.77
- F1-score and recall: 0.81

CNN Architecture - With data augmentation

Layer (type)	Output Shape	Param #
conv2d_18 (Conv2D)	(None, 32, 32, 64)	1792
batch_normalization_18 (BatchNormalization)	(None, 32, 32, 64)	256
conv2d_19 (Conv2D)	(None, 32, 32, 64)	36928
batch_normalization_19 (BatchNormalization)	(None, 32, 32, 64)	256
max_pooling2d_9 (MaxPooling2D)	(None, 16, 16, 64)	0
conv2d_20 (Conv2D)	(None, 16, 16, 128)	73856
batch_normalization_20 (BatchNormalization)	(None, 16, 16, 128)	512
conv2d_21 (Conv2D)	(None, 16, 16, 128)	147584
batch_normalization_21 (BatchNormalization)	(None, 16, 16, 128)	512
max_pooling2d_10 (MaxPooling2D)	(None, 8, 8, 128)	0
conv2d_22 (Conv2D)	(None, 8, 8, 256)	295168
batch_normalization_22 (BatchNormalization)	(None, 8, 8, 256)	1024
conv2d_23 (Conv2D)	(None, 8, 8, 256)	590080
batch_normalization_23 (BatchNormalization)	(None, 8, 8, 256)	1024
max_pooling2d_11 (MaxPooling2D)	(None, 4, 4, 256)	0
flatten_3 (Flatten)	(None, 4096)	0
dense_6 (Dense)	(None, 256)	1048832
dropout_6 (Dropout)	(None, 256)	0
dense_7 (Dense)	(None, 10)	2570

Total params: 2200394 (8.39 MB)
Trainable params: 2198602 (8.39 MB)
Non-trainable params: 1792 (7.00 KB)





- Optimizer/Loss: Adam / Cat. Crossentropy
- Epochs: 50
- Test accuracy: 0.91
- Test loss: 0.67
- F1-score and recall: 0.91

Models Architectures

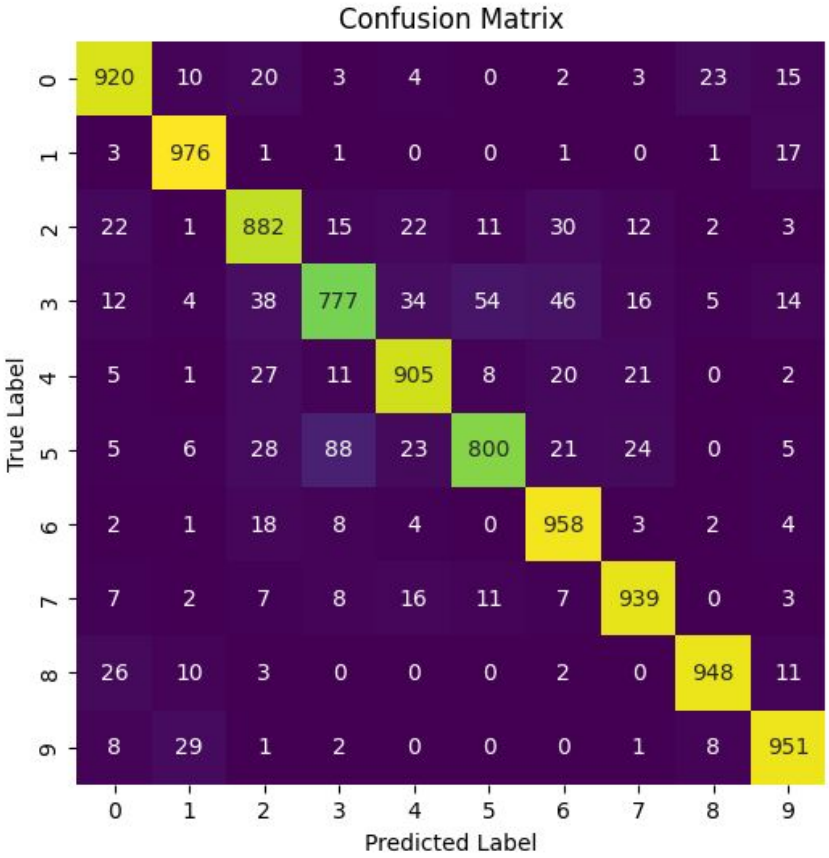
- Homemade classifier
- Transfer learning / Fine TuningVGG16
- Transfer learning / Fine Tunni ResNet50

Models Architectures

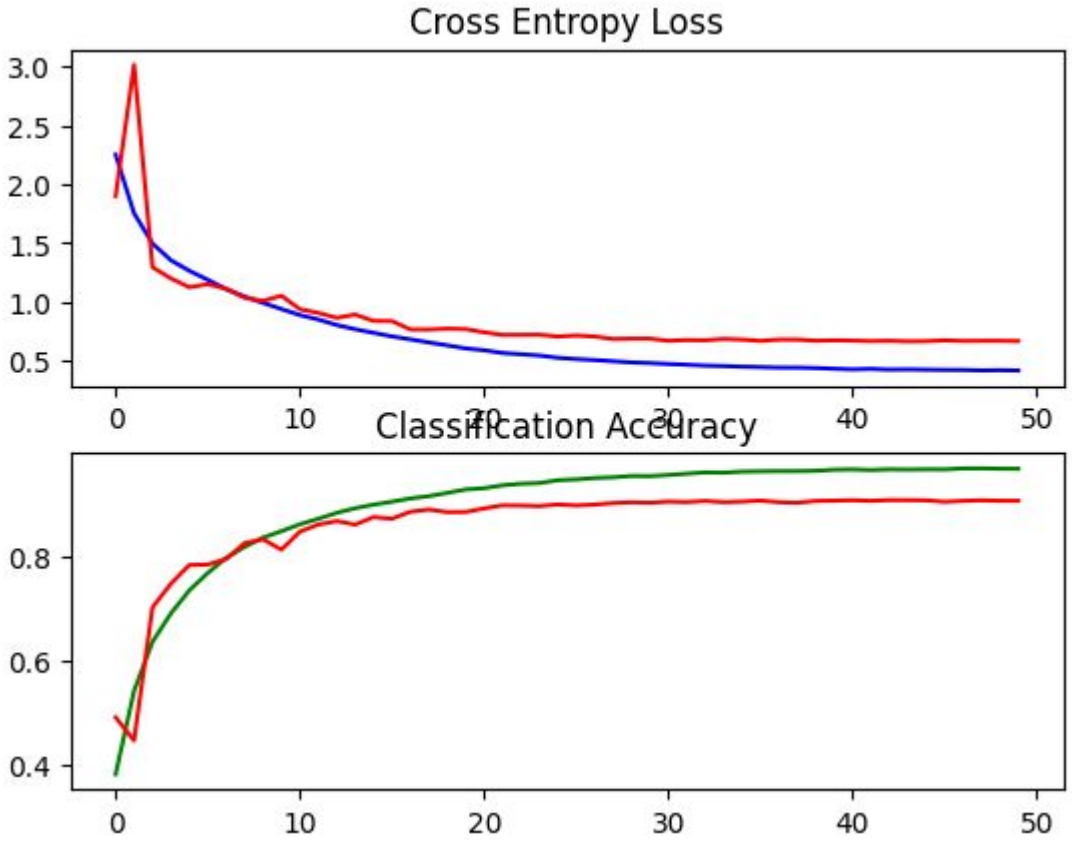
- Homemade classifier

Test Acc.	Test Loss	Parameters
0.91	0.67	2,200,394

Models Architectures



Models Architectures

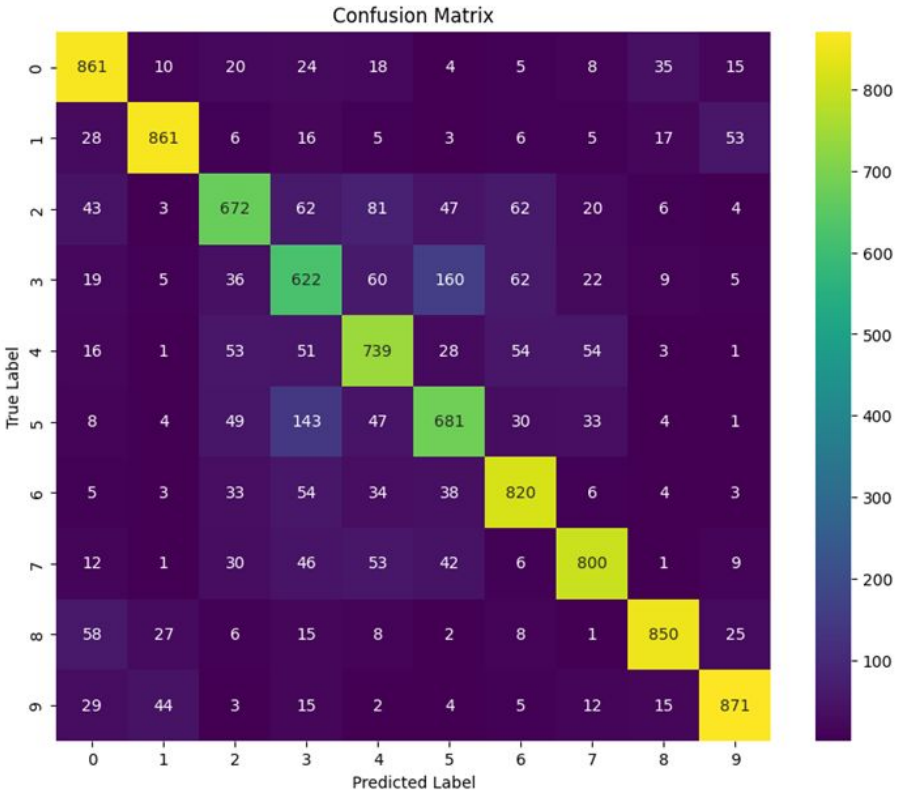


Models Architectures

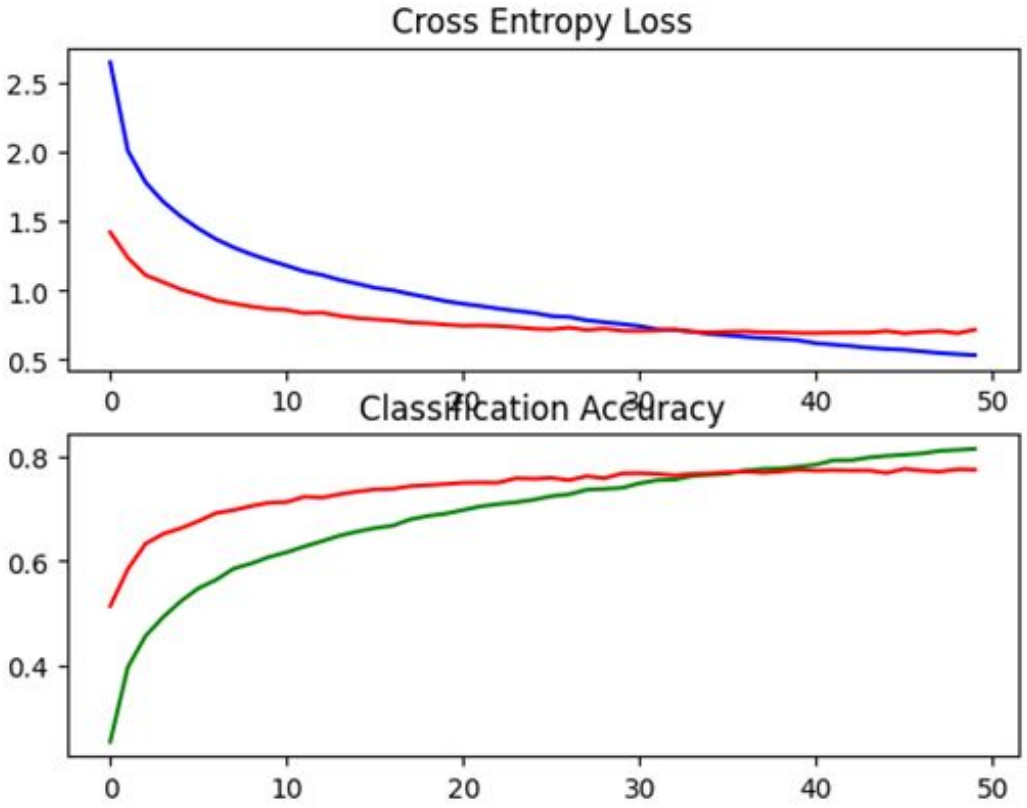
- Transfer learning / Fine Tuning VGG16 KK

Test Acc.	Test Loss	Parameters
0.84	0.54	41,071,690

Models Architectures



Models Architectures

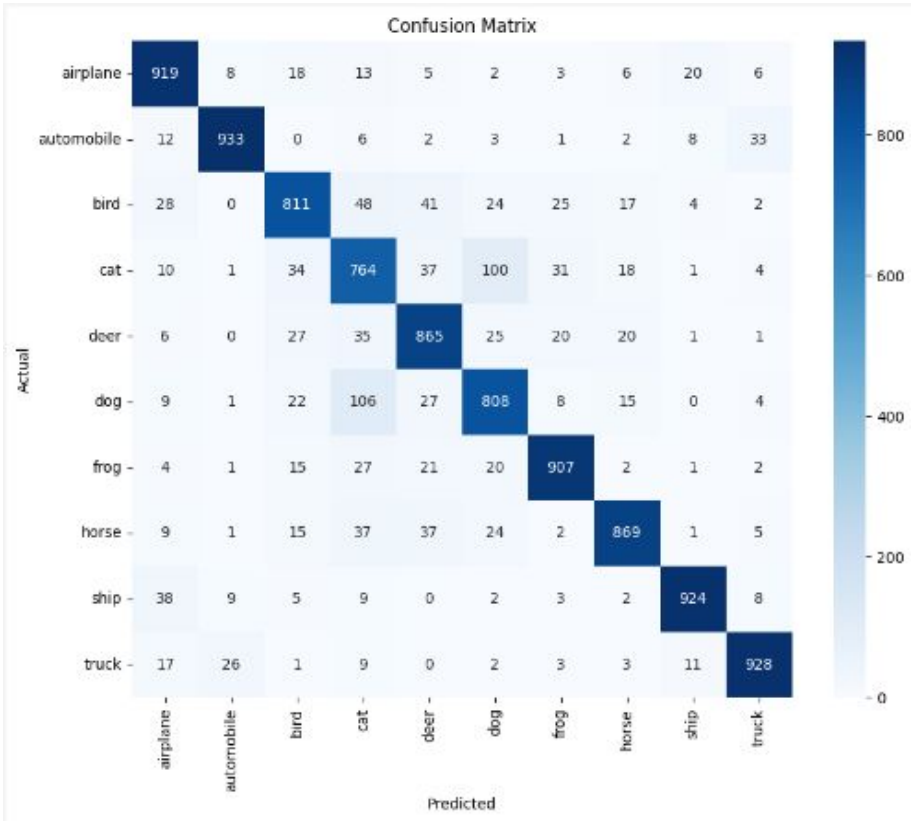


Models Architectures

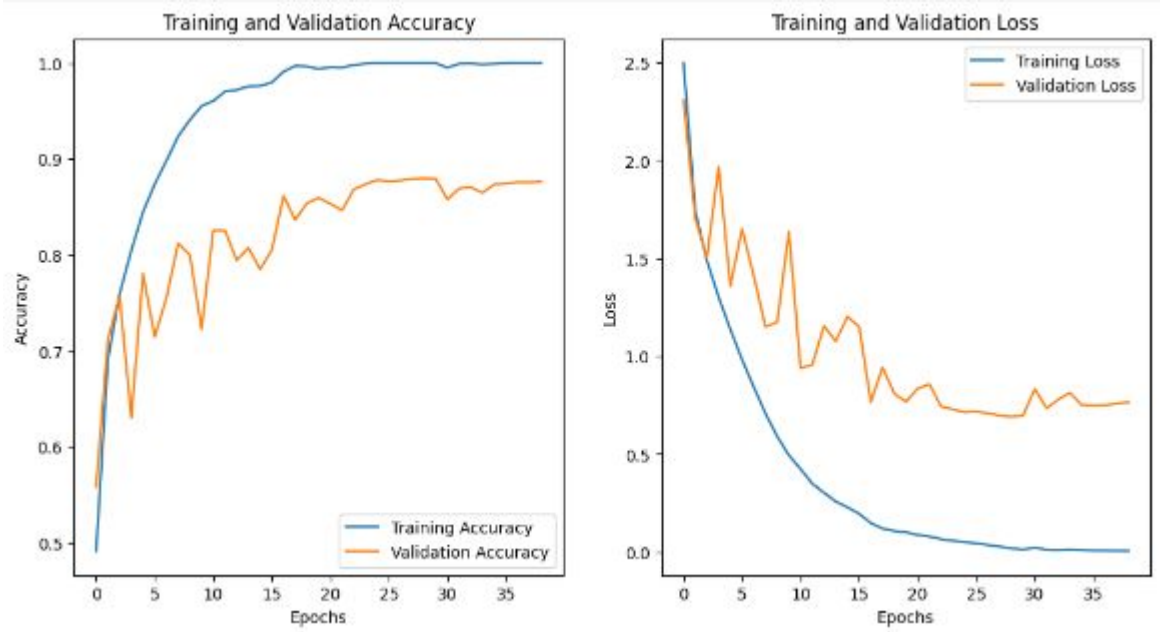
- Transfer learning / Fine Tuning VGG16 Freddy

Test Acc.	Test Loss	Parameters
0.88	0.76	4.101.450

Models Architectures



Models Architectures

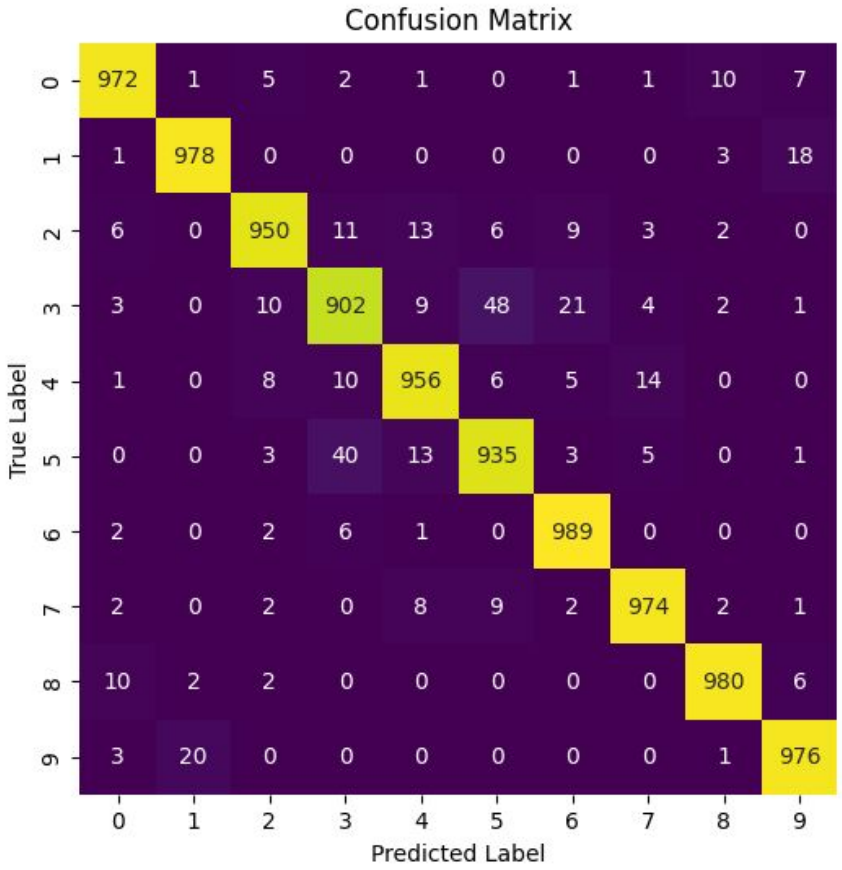


Models Architectures

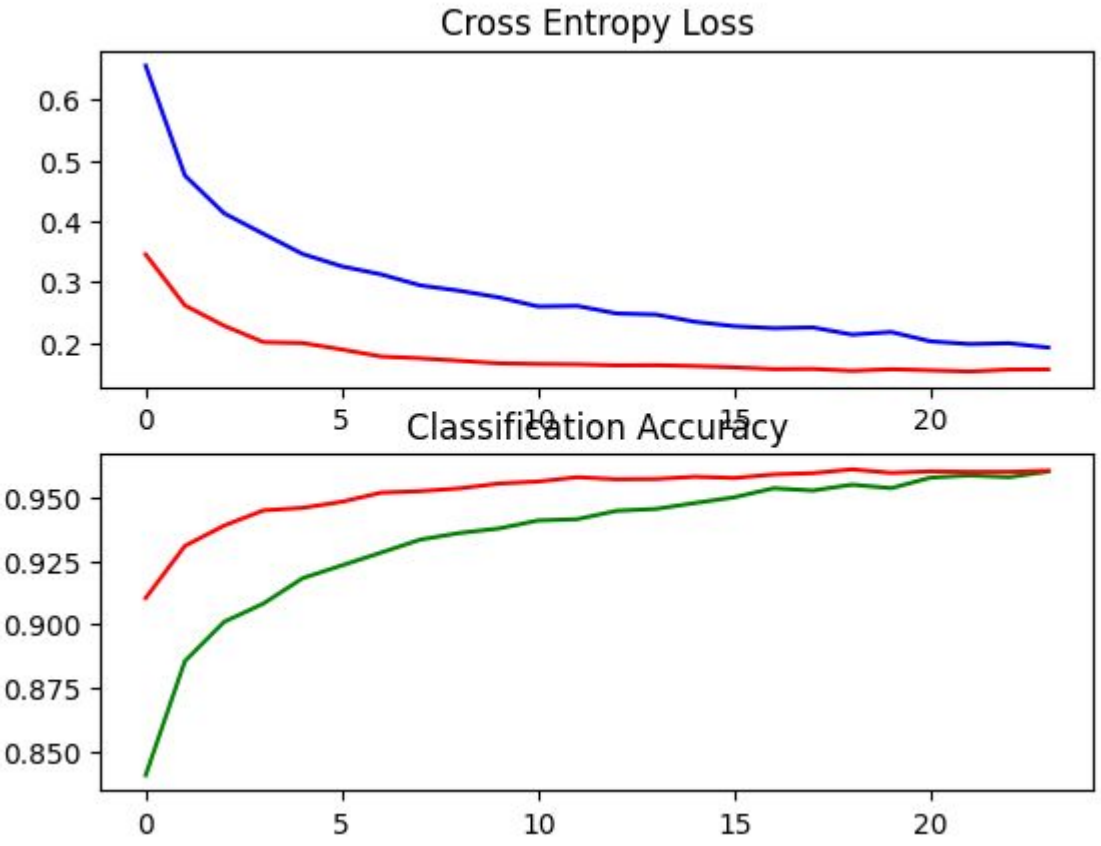
- Transfer learning / ResNet50

Test Acc.	Test Loss	Parameters
0.95	0.17	49,723,082

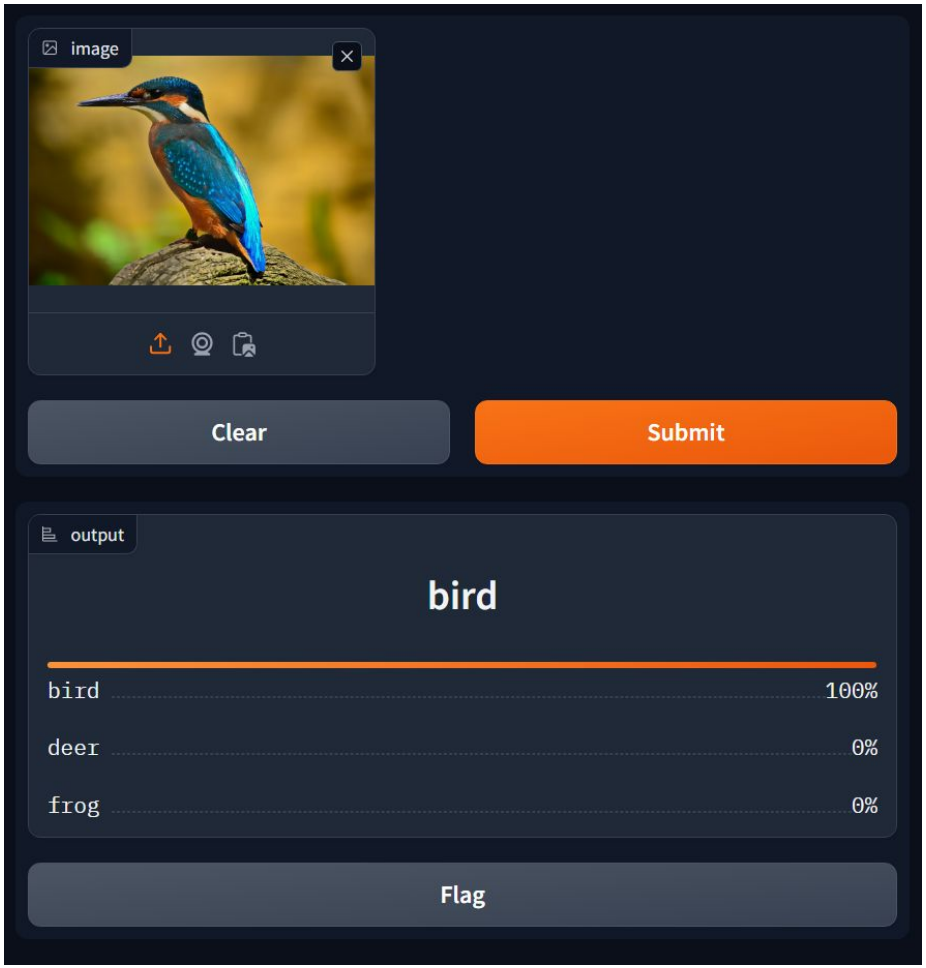
Models Architectures



Models Architectures



Deployment



https://8678cdb3961f955800.gradio.live/

Conclusion

Model Architecture	Dev	Total Layers	Dense	Params	Epochs	DataAug.	BatchNorm.	Dropout	Optimizer	Loss	Test Acc	Test Loss	f1-score	recall	Comments
Home-made CNN (v3)	Alexandre	18	2	2,196,810.00	15		X		Adam	cat_cross	0.81	0.77	0.81	0.81	Overfitting
Home-made CNN (v4)	Alexandre	19	2	2,200,394.00	20	X	X	X	Adam	cat_cross	0.91	0.67	0.91	0.91	No more overfitting
Home-made CNN	Freddy	12	2	4,101,450.00	50	X	X	X	Adam w/Scheduler	cat_cross	0.8195	1.1084	0.81	0.81	Some overfit
Home-made CNN	KK	18	2	3,514,698.00	50	X	X	X	Adam	cat_cross	0.9	0.35	0.9	0.9	Final Model
VGG16 TransferLearn	KK	25	3	41,071,690.00	50		X	X	Adam	cat_cross	0.78	0.69	0.78	0.78	Close to Train accuracy of 0.81 & loss of 0.535
VGG16 Finetuning	KK	25	3	41,071,690.00	30		X	X	Adam	cat_cross	0.84	0.54	0.84	0.84	Training acc 0.94 & loss 0.16, bit of Overfit.
VGG16 TransferLearn- DA	KK	25	3	41,071,690.00	100	X	X	X	Adam	cat_cross	0.68	0.89	0.68	0.68	Bad Training accuracy of 0.64 & loss of 1.00
VGG16 Finetuning - DA	KK	25	3	41,071,690.00	50	X	X	X	Adam	cat_cross	0.78	0.65	0.78	0.78	Close to Training acc 0.85 & loss 0.43. Can improve!
VGG16 TransLearn	Freddy	12	3	4,101,450.00	50	X	X	X	Adam/wscheduler	cat_cross	0.87	0.99	0.87	0.87	Improvement of validation accuracy. Persintent loss spiking
ResNet50 TransLearn	Alexandre	188	4	49,723,082.00	20	X	X	X	RMSProp	cat_cross	0.95	0.17	0.95	0.95	Best one so far
ResNet50 TransLearn	Alexandre	188	4	49,723,082.00	24	X	X	X	RMSProp	cat_cross	0.96	0.15	0.96	0.96	Fine-tuning did not work. Wrong predictions on new images.

Thank You :)

Questions??