

## Assignment-1 Dogs vs Cats

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For this assignment to be able to understand how things change with batch normalization, dropouts, and how activation functions make a difference in how the model learns and predicts. Including the time and the learning rate of the models. To understand I designed 3 models, removing dropout and then normalization and then both. I used Early stopping to prevent the model from over fitting the model. Adjusted the learning rate of the system.

Model	1	2	3
F1_score	0.85	0.92	0.91
Sensitivity	0.84	0.96	0.92
ROC_AUC Score	0.86	0.92	0.91
Training accuracy	0.88	0.9305	0.91
Validation accuracy	0.81	0.9156	0.91
Loss	0.28	0.1741	0.22
Validation loss	0.41	0.1971	0.25

Model 1:

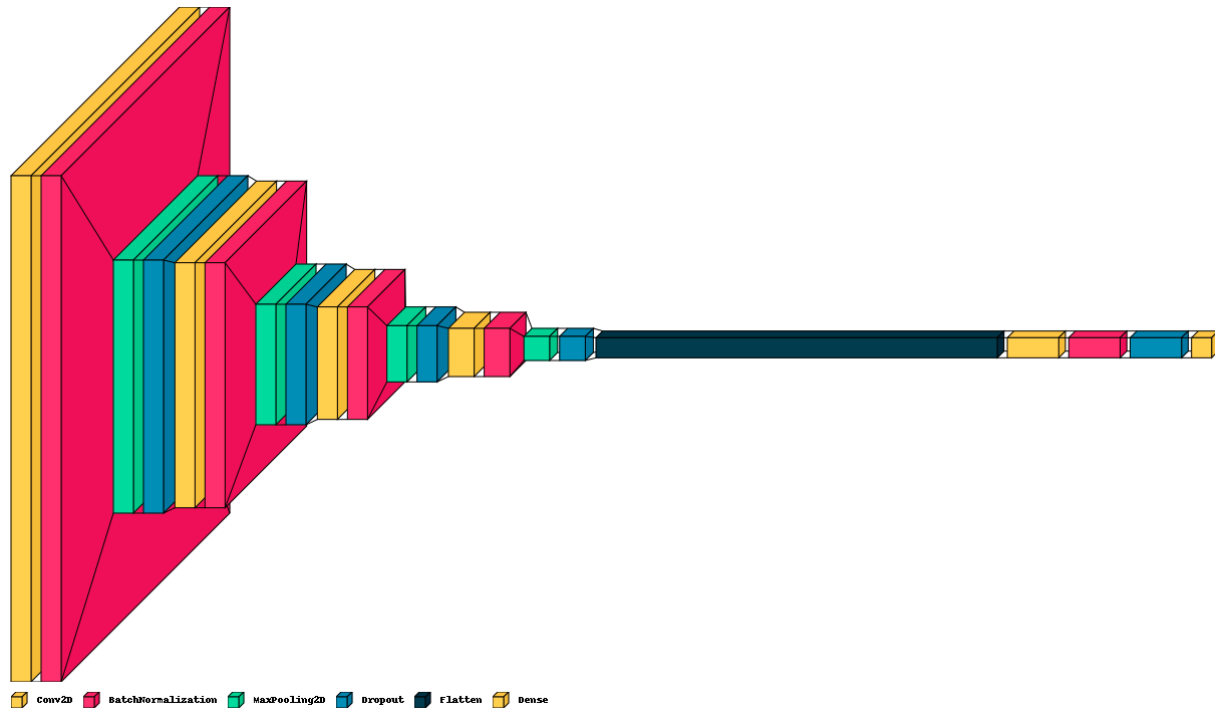


Fig 1: Model 1 representation



Fig 2: Model 1 accuracy

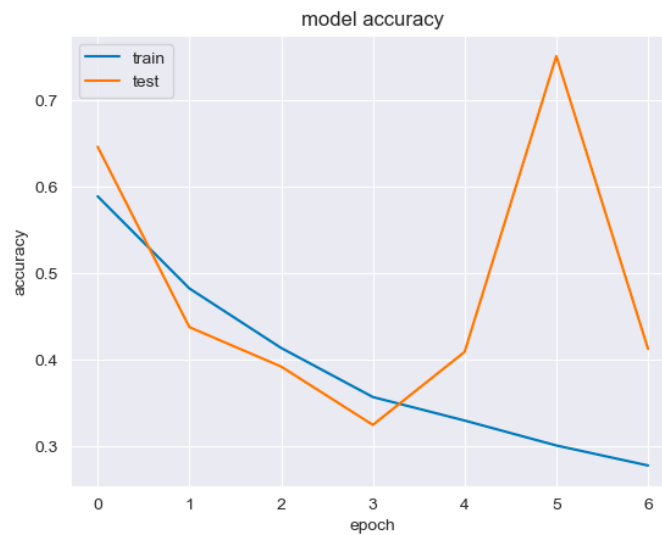


Fig 3: Model 1 loss

### Model 1 parameters and list

Model: "sequential"

Layer (type)	Output Shape	Param #
=====		
conv2d (Conv2D)	(None, 126, 126, 32)	896
batch_normalization (Batch Normalization)	(None, 126, 126, 32)	128
max_pooling2d (MaxPooling2D)	(None, 63, 63, 32)	0

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dropout (Dropout)	(None, 63, 63, 32)	0
conv2d_1 (Conv2D)	(None, 61, 61, 64)	18496
batch_normalization_1 (Batch Normalization)	(None, 61, 61, 64)	256
max_pooling2d_1 (MaxPooling2D)	(None, 30, 30, 64)	0
dropout_1 (Dropout)	(None, 30, 30, 64)	0
conv2d_2 (Conv2D)	(None, 28, 28, 128)	73856
batch_normalization_2 (Batch Normalization)	(None, 28, 28, 128)	512
max_pooling2d_2 (MaxPooling2D)	(None, 14, 14, 128)	0
dropout_2 (Dropout)	(None, 14, 14, 128)	0
conv2d_3 (Conv2D)	(None, 12, 12, 256)	295168
batch_normalization_3 (Batch Normalization)	(None, 12, 12, 256)	1024
max_pooling2d_3 (MaxPooling2D)	(None, 6, 6, 256)	0
dropout_3 (Dropout)	(None, 6, 6, 256)	0
flatten (Flatten)	(None, 9216)	0
dense (Dense)	(None, 512)	4719104
batch_normalization_4 (Batch Normalization)	(None, 512)	2048
dropout_4 (Dropout)	(None, 512)	0
dense_1 (Dense)	(None, 2)	1026

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Total params: 5,112,514  
Trainable params: 5,110,530  
Non-trainable params: 1,984

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Output layer activation: SoftMax  
All other layers: reLu

Model 2 Results: No DROPOUT

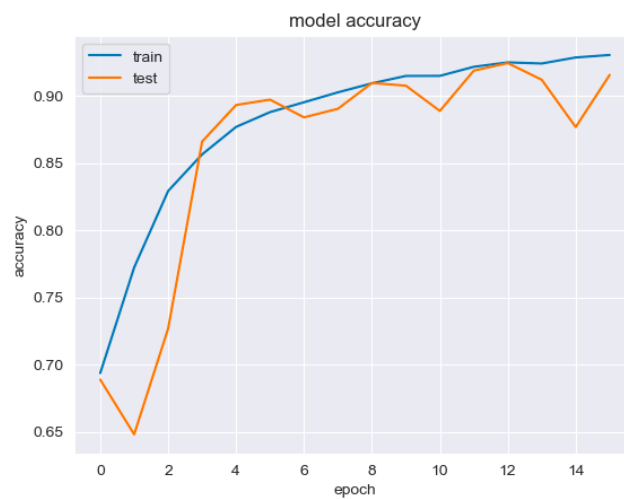


Fig 4 : Model 2 accuracy

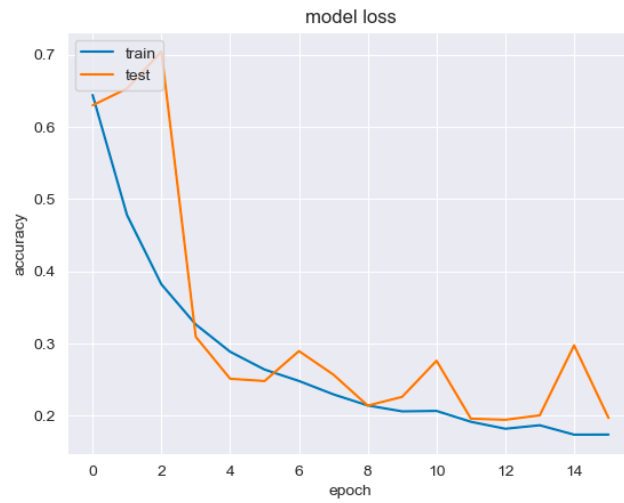


Fig 5 : Model 2 loss

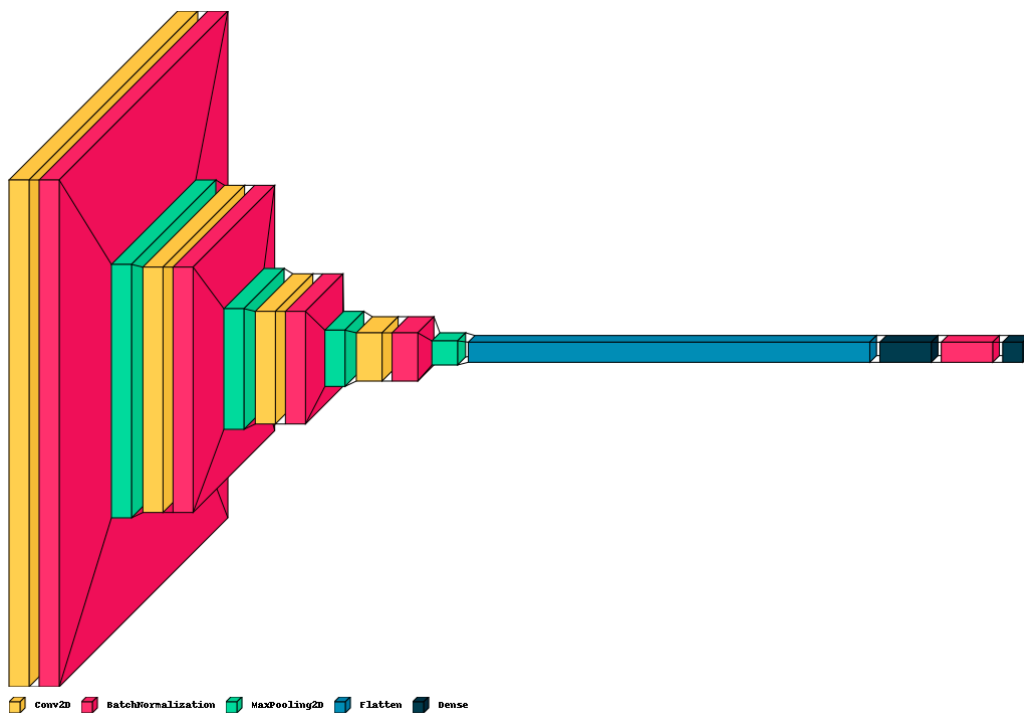


Fig 6 : Model 2 visual representation

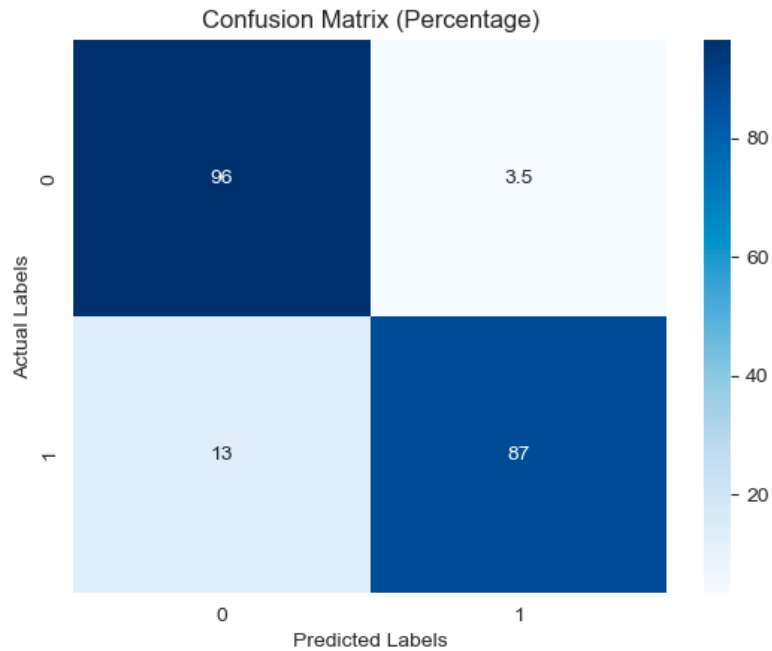


Fig 7 : Confusion Matrix showing cats vs dogs

0 – Dog  
1 - Cat

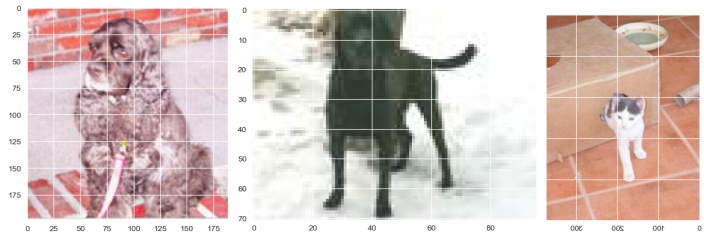


Fig 8 : Misclassified images

Model: "sequential\_5"

Layer (type)	Output Shape	Param #
conv2d_20 (Conv2D)	(None, 126, 126, 32)	896
batch_normalization_25 (Batch Normalization)	(None, 126, 126, 32)	128
max_pooling2d_20 (MaxPooling2D)	(None, 63, 63, 32)	0
conv2d_21 (Conv2D)	(None, 61, 61, 64)	18496

batch_normalization_26 (Batch Normalization)	(None, 61, 61, 64)	256
max_pooling2d_21 (MaxPooling2D)	(None, 30, 30, 64)	0
conv2d_22 (Conv2D)	(None, 28, 28, 128)	73856
batch_normalization_27 (Batch Normalization)	(None, 28, 28, 128)	512
max_pooling2d_22 (MaxPooling2D)	(None, 14, 14, 128)	0
conv2d_23 (Conv2D)	(None, 12, 12, 256)	295168
batch_normalization_28 (Batch Normalization)	(None, 12, 12, 256)	1024
max_pooling2d_23 (MaxPooling2D)	(None, 6, 6, 256)	0
flatten_5 (Flatten)	(None, 9216)	0
dense_10 (Dense)	(None, 512)	4719104
batch_normalization_29 (Batch Normalization)	(None, 512)	2048
dense_11 (Dense)	(None, 2)	1026

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=====
Total params: 5,112,514
Trainable params: 5,110,530
Non-trainable params: 1,984

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Output layer activation: Sigmoid  
All other layers: reLu

### Model 3 : No Normalization and drop outs

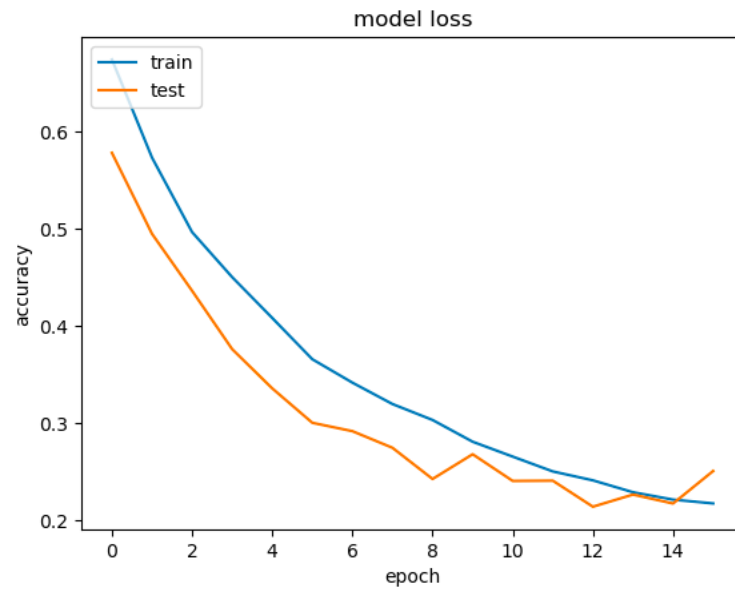


Fig 9 : Model 3 loss

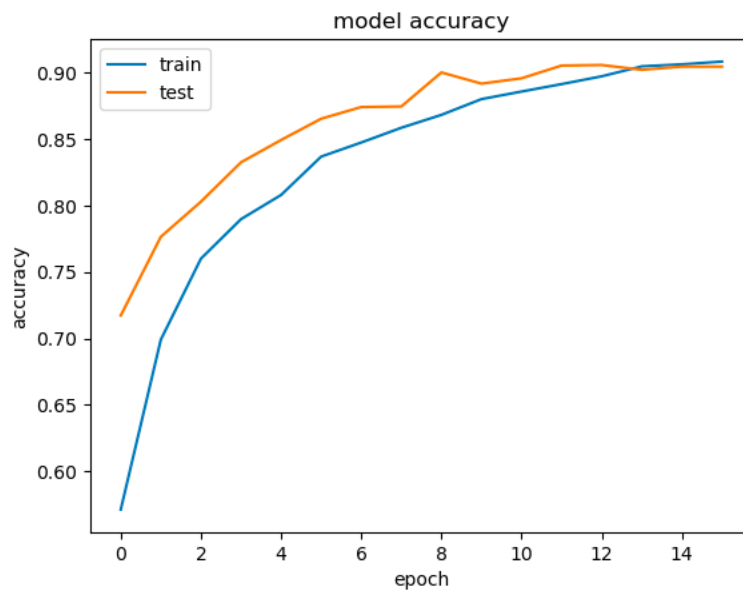


Fig 10 : Model 3 accuracy



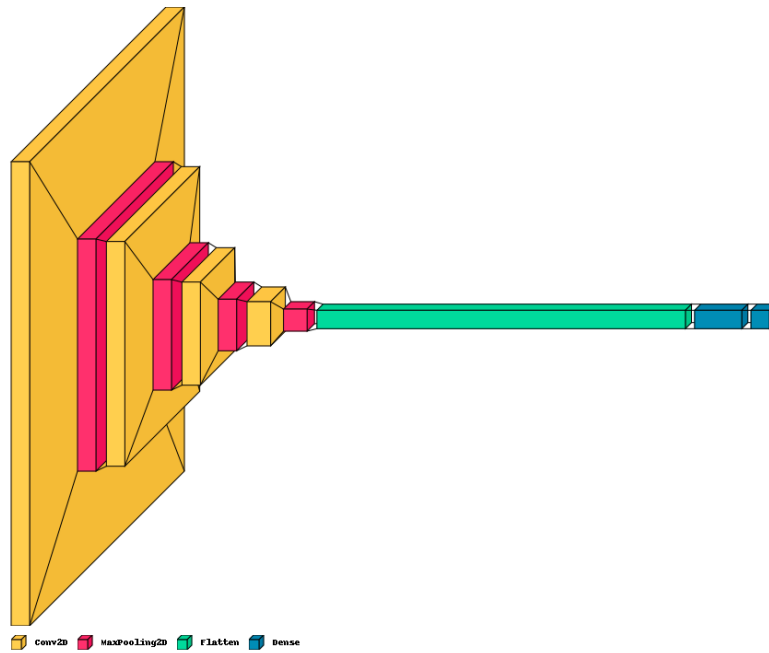


Fig 11: Model 3 visual representation

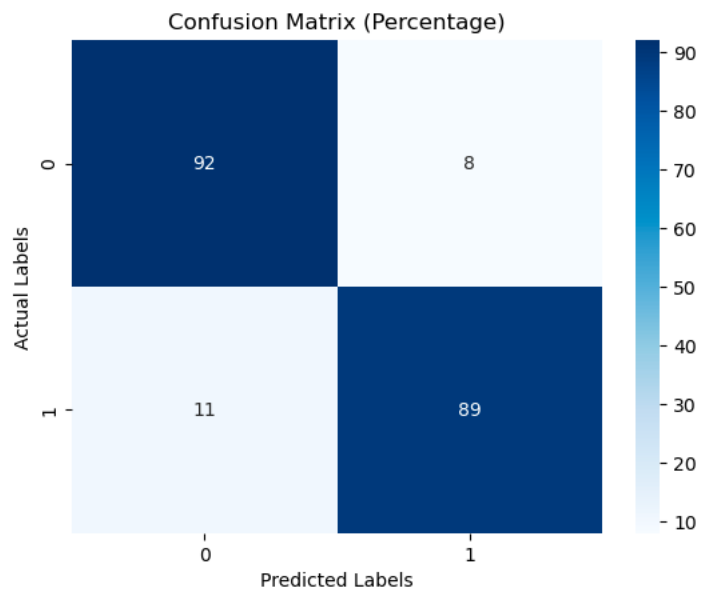


Fig 12 : Confusion matrix showing Dogs vs Cats

Model: "sequential\_1"

Layer (type)	Output Shape	Param #
=====		
conv2d_4 (Conv2D)	(None, 126, 126, 32)	896
max_pooling2d_4 (MaxPooling 2D)	(None, 63, 63, 32)	0
conv2d_5 (Conv2D)	(None, 61, 61, 64)	18496
max_pooling2d_5 (MaxPooling 2D)	(None, 30, 30, 64)	0
conv2d_6 (Conv2D)	(None, 28, 28, 128)	73856
max_pooling2d_6 (MaxPooling 2D)	(None, 14, 14, 128)	0
conv2d_7 (Conv2D)	(None, 12, 12, 256)	295168
max_pooling2d_7 (MaxPooling 2D)	(None, 6, 6, 256)	0
flatten_1 (Flatten)	(None, 9216)	0
dense_2 (Dense)	(None, 512)	4719104
dense_3 (Dense)	(None, 2)	1026
=====		
Total params: 5,108,546		
Trainable params: 5,108,546		
Non-trainable params: 0		
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