

Model Development Phase Template

Date	23 feb 2026
Team ID	LTVIP2026TMIDS50689
Project Title	Dog Breed Identification using Transfer Learning
Maximum Marks	10 Marks

Initial Model Training Code, Model Validation and Evaluation Report

The initial model training code will be showcased in the future through a screenshot. The model validation and evaluation report will include a summary and training and validation performance metrics for multiple models, presented through respective screenshots.

Initial Model Training Code (5 marks):

```
vgg16.fit(train_generator, validation_data = test_generator, epochs=10 )
```

```
resnet.fit(train_generator, validation_data = test_generator, epochs=10 )
```

```
inception.fit(train_generator, validation_data = test_generator, epochs=10 )
```

```
xception.fit(train_generator, validation_data = test_generator, epochs=10 )
```

Model Validation and Evaluation Report (5 marks):

Model	Summary	Training and Validation Performance Metrics																																																																																	
Model 1	<div><div>Model: "model"</div><table><tr><th>Layer (type)</th><th>Output Shape</th><th>Param #</th></tr><tr><td colspan="3">=====</td></tr><tr><td>input_1 (InputLayer)</td><td>[(None, 224, 224, 3)]</td><td>0</td></tr><tr><td>block1_conv1 (Conv2D)</td><td>(None, 224, 224, 64)</td><td>1792</td></tr><tr><td>block1_conv2 (Conv2D)</td><td>(None, 224, 224, 64)</td><td>36928</td></tr><tr><td>block1_pool (MaxPooling2D)</td><td>(None, 112, 112, 64)</td><td>0</td></tr><tr><td>block2_conv1 (Conv2D)</td><td>(None, 112, 112, 128)</td><td>73856</td></tr><tr><td>block2_conv2 (Conv2D)</td><td>(None, 112, 112, 128)</td><td>147584</td></tr><tr><td>block2_pool (MaxPooling2D)</td><td>(None, 56, 56, 128)</td><td>0</td></tr><tr><td>block3_conv1 (Conv2D)</td><td>(None, 56, 56, 256)</td><td>295168</td></tr><tr><td>block3_conv2 (Conv2D)</td><td>(None, 56, 56, 256)</td><td>590880</td></tr><tr><td>block3_conv3 (Conv2D)</td><td>(None, 56, 56, 256)</td><td>590880</td></tr><tr><td>block3_pool (MaxPooling2D)</td><td>(None, 28, 28, 256)</td><td>0</td></tr><tr><td>block4_conv1 (Conv2D)</td><td>(None, 28, 28, 512)</td><td>1180160</td></tr><tr><td>block4_conv2 (Conv2D)</td><td>(None, 28, 28, 512)</td><td>2359808</td></tr><tr><td>block4_conv3 (Conv2D)</td><td>(None, 28, 28, 512)</td><td>2359808</td></tr><tr><td>block4_pool (MaxPooling2D)</td><td>(None, 14, 14, 512)</td><td>0</td></tr><tr><td>block5_conv1 (Conv2D)</td><td>(None, 14, 14, 512)</td><td>2359808</td></tr><tr><td>block5_conv2 (Conv2D)</td><td>(None, 14, 14, 512)</td><td>2359808</td></tr><tr><td>block5_conv3 (Conv2D)</td><td>(None, 14, 14, 512)</td><td>2359808</td></tr><tr><td>block5_pool (MaxPooling2D)</td><td>(None, 7, 7, 512)</td><td>0</td></tr><tr><td>flatten (Flatten)</td><td>(None, 25088)</td><td>0</td></tr><tr><td>dense (Dense)</td><td>(None, 8)</td><td>200712</td></tr><tr><td colspan="3">=====</td></tr><tr><td colspan="3">Total params: 14915400 (56.90 MB)</td></tr><tr><td colspan="3">Trainable params: 200712 (784.03 KB)</td></tr><tr><td colspan="3">Non-trainable params: 14714688 (56.13 MB)</td></tr></table></div>	Layer (type)	Output Shape	Param #	=====			input_1 (InputLayer)	[(None, 224, 224, 3)]	0	block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792	block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928	block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0	block2_conv1 (Conv2D)	(None, 112, 112, 128)	73856	block2_conv2 (Conv2D)	(None, 112, 112, 128)	147584	block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0	block3_conv1 (Conv2D)	(None, 56, 56, 256)	295168	block3_conv2 (Conv2D)	(None, 56, 56, 256)	590880	block3_conv3 (Conv2D)	(None, 56, 56, 256)	590880	block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0	block4_conv1 (Conv2D)	(None, 28, 28, 512)	1180160	block4_conv2 (Conv2D)	(None, 28, 28, 512)	2359808	block4_conv3 (Conv2D)	(None, 28, 28, 512)	2359808	block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0	block5_conv1 (Conv2D)	(None, 14, 14, 512)	2359808	block5_conv2 (Conv2D)	(None, 14, 14, 512)	2359808	block5_conv3 (Conv2D)	(None, 14, 14, 512)	2359808	block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0	flatten (Flatten)	(None, 25088)	0	dense (Dense)	(None, 8)	200712	=====			Total params: 14915400 (56.90 MB)			Trainable params: 200712 (784.03 KB)			Non-trainable params: 14714688 (56.13 MB)			<div><pre>sgg16.Fit(train_generator,validation_data = test_generator,epochs=10)</pre><pre>Epoch 1/10 15/12 [=====] - 27s 1s/step - loss: 2.2112 - accuracy: 0.7500 - val_loss: 1.4055 - val_accuracy: 0.4286 Epoch 2/10 15/12 [=====] - 9s 747ms/step - loss: 1.2505 - accuracy: 0.5708 - val_loss: 0.9771 - val_accuracy: 0.7143 Epoch 3/10 15/12 [=====] - 8s 679ms/step - loss: 0.8296 - accuracy: 0.7181 - val_loss: 0.9401 - val_accuracy: 0.7143 Epoch 4/10 15/12 [=====] - 10s 830ms/step - loss: 0.6643 - accuracy: 0.7608 - val_loss: 0.6189 - val_accuracy: 0.8571 Epoch 5/10 15/12 [=====] - 10s 849ms/step - loss: 0.5785 - accuracy: 0.8191 - val_loss: 0.5487 - val_accuracy: 0.8571 Epoch 6/10 15/12 [=====] - 9s 710ms/step - loss: 0.4333 - accuracy: 0.8777 - val_loss: 0.2663 - val_accuracy: 0.8571 Epoch 7/10 15/12 [=====] - 10s 803ms/step - loss: 0.4174 - accuracy: 0.9043 - val_loss: 0.2756 - val_accuracy: 1.0000 Epoch 8/10 15/12 [=====] - 10s 830ms/step - loss: 0.3417 - accuracy: 0.9389 - val_loss: 0.2725 - val_accuracy: 0.8571 Epoch 9/10 15/12 [=====] - 8s 682ms/step - loss: 0.3489 - accuracy: 0.9069 - val_loss: 0.1049 - val_accuracy: 1.0000 Epoch 10/10 15/12 [=====] - 9s 683ms/step - loss: 0.2907 - accuracy: 0.9302 - val_loss: 0.1168 - val_accuracy: 1.0000 callbacks.get_callbacks().history at 0x70b3d4f0000</pre></div>
Layer (type)	Output Shape	Param #																																																																																	
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input_1 (InputLayer)	[(None, 224, 224, 3)]	0																																																																																	
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Non-trainable params: 14714688 (56.13 MB)																																																																																			

Model 2

```
conv5_block2_2_conv (Conv2D) (None, 7, 7, 512) 2150888 ['conv5_block2_2_conv[0][0]']
conv5_block2_2_bn (BatchNormalisation) (None, 7, 7, 512) 2048 ['conv5_block2_2_bn[0][0]']
conv5_block2_2_relu (Activation) (None, 7, 7, 512) 0 ['conv5_block2_2_relu[0][0]']
conv5_block3_1_conv (Conv2D) (None, 7, 7, 2048) 1050624 ['conv5_block3_1_conv[0][0]']
conv5_block3_1_bn (BatchNormalisation) (None, 7, 7, 2048) 8192 ['conv5_block3_1_bn[0][0]']
conv5_block3_1_add (Add) (None, 7, 7, 2048) 0 ['conv5_block3_1_add[0][0]', 'conv5_block2_2_bn[0][0]']
conv5_block3_1_out (Activation) (None, 7, 7, 2048) 0 ['conv5_block3_1_out[0][0]']
conv5_block3_1_conv (Conv2D) (None, 7, 7, 512) 1049088 ['conv5_block3_1_conv[0][0]']
conv5_block3_1_bn (BatchNormalisation) (None, 7, 7, 512) 2048 ['conv5_block3_1_bn[0][0]']
conv5_block3_1_relu (Activation) (None, 7, 7, 512) 0 ['conv5_block3_1_relu[0][0]']
conv5_block3_2_conv (Conv2D) (None, 7, 7, 512) 2048 ['conv5_block3_2_conv[0][0]']
conv5_block3_2_bn (BatchNormalisation) (None, 7, 7, 512) 0 ['conv5_block3_2_bn[0][0]']
conv5_block3_2_relu (Activation) (None, 7, 7, 512) 0 ['conv5_block3_2_relu[0][0]']
conv5_block3_3_conv (Conv2D) (None, 7, 7, 2048) 1050624 ['conv5_block3_3_conv[0][0]']
conv5_block3_3_bn (BatchNormalisation) (None, 7, 7, 2048) 8192 ['conv5_block3_3_bn[0][0]']
conv5_block3_3_add (Add) (None, 7, 7, 2048) 0 ['conv5_block3_3_add[0][0]', 'conv5_block3_2_bn[0][0]']
conv5_block3_3_out (Activation) (None, 7, 7, 2048) 0 ['conv5_block3_3_out[0][0]']
flatten_1 (Flatten) (None, 100352) 0 ['conv5_block3_3_out[0][0]']
dense_1 (Dense) (None, 8) 803824 ['flatten_1[0][0]']

Total params: 24590536 (93.04 MB)
Trainable params: 802824 (3.06 MB)
```

```
reset_fit(train_generator, validation_data = test_generator, epochs=10 )

Epoch 1/10
12/12 [=====] - 17s 94ms/step - loss: 8.6675 - accuracy: 0.1436 - val_loss: 6.4575 - val_accuracy: 0.1429
Epoch 2/10
12/12 [=====] - 8s 64ms/step - loss: 6.9999 - accuracy: 0.1356 - val_loss: 3.4116 - val_accuracy: 0.4286
Epoch 3/10
12/12 [=====] - 8s 63ms/step - loss: 4.2426 - accuracy: 0.1862 - val_loss: 2.2663 - val_accuracy: 0.1429
Epoch 4/10
12/12 [=====] - 9s 77ms/step - loss: 2.8612 - accuracy: 0.2207 - val_loss: 2.5258 - val_accuracy: 0.2857
Epoch 5/10
12/12 [=====] - 9s 75ms/step - loss: 2.5177 - accuracy: 0.2340 - val_loss: 1.5863 - val_accuracy: 0.2857
Epoch 6/10
12/12 [=====] - 8s 65ms/step - loss: 2.2711 - accuracy: 0.2840 - val_loss: 1.5330 - val_accuracy: 0.5714
Epoch 7/10
12/12 [=====] - 9s 77ms/step - loss: 2.2721 - accuracy: 0.2380 - val_loss: 1.4668 - val_accuracy: 0.4286
Epoch 8/10
12/12 [=====] - 9s 77ms/step - loss: 2.0657 - accuracy: 0.2606 - val_loss: 1.5892 - val_accuracy: 0.4286
Epoch 9/10
12/12 [=====] - 8s 64ms/step - loss: 1.9884 - accuracy: 0.2926 - val_loss: 1.5387 - val_accuracy: 0.4286
Epoch 10/10
12/12 [=====] - 9s 76ms/step - loss: 2.7414 - accuracy: 0.1835 - val_loss: 2.1363 - val_accuracy: 0.4286
Chorus src call backs history at 0x7cd504b0800
```

Model 3

```
inception_summary()
batch_normalization_87 (BatchNormalisation) (None, 8, 8, 384) 1152 ['conv2d_87[0][0]']
batch_normalization_88 (BatchNormalisation) (None, 8, 8, 384) 1152 ['conv2d_88[0][0]']
batch_normalization_91 (BatchNormalisation) (None, 8, 8, 384) 1152 ['conv2d_91[0][0]']
batch_normalization_92 (BatchNormalisation) (None, 8, 8, 384) 1152 ['conv2d_92[0][0]']
conv2d_93 (Conv2D) (None, 8, 8, 192) 393216 ['average_pooling2d_8[0][0]']
batch_normalization_85 (BatchNormalisation) (None, 8, 8, 320) 960 ['conv2d_85[0][0]']
activation_87 (Activation) (None, 8, 8, 384) 0 ['batch_normalization_87[0][0]']
activation_88 (Activation) (None, 8, 8, 384) 0 ['batch_normalization_88[0][0]']
activation_91 (Activation) (None, 8, 8, 384) 0 ['batch_normalization_91[0][0]']
activation_92 (Activation) (None, 8, 8, 384) 0 ['batch_normalization_92[0][0]']
batch_normalization_93 (BatchNormalisation) (None, 8, 8, 192) 576 ['conv2d_93[0][0]']
activation_85 (Activation) (None, 8, 8, 320) 0 ['batch_normalization_85[0][0]']
mixed9_1 (Concatenate) (None, 8, 8, 768) 0 ['activation_87[0][0]', 'activation_88[0][0]']
concatenate_1 (Concatenate) (None, 8, 8, 768) 0 ['activation_91[0][0]', 'activation_92[0][0]']
activation_93 (Activation) (None, 8, 8, 192) 0 ['batch_normalization_93[0][0]']
mixed10 (Concatenate) (None, 8, 8, 2048) 0 ['activation_85[0][0]', 'mixed9_1[0][0]', 'concatenate_1[0][0]', 'activation_93[0][0]']
flatten_2 (Flatten) (None, 131072) 0 ['mixed10[0][0]']
dense_2 (Dense) (None, 8) 1048544 ['flatten_2[0][0]']

Total params: 22851368 (87.17 MB)
Trainable params: 22818936 (87.04 MB)
Non-trainable params: 36432 (134.50 KB)
```

```
inception_fit(train_generator, validation_data = test_generator, epochs=10 )

Epoch 1/10
12/12 [=====] - 74s 2s/step - loss: 18.1741 - accuracy: 0.2128 - val_loss: 18236.6914 - val_accuracy: 0.1429
Epoch 2/10
12/12 [=====] - 14s 1s/step - loss: 8.7789 - accuracy: 0.1941 - val_loss: 11863.7734 - val_accuracy: 0.1429
Epoch 3/10
12/12 [=====] - 14s 1s/step - loss: 5.5277 - accuracy: 0.2181 - val_loss: 74852.1250 - val_accuracy: 0.1429
Epoch 4/10
12/12 [=====] - 14s 1s/step - loss: 3.1899 - accuracy: 0.1889 - val_loss: 136493.8584 - val_accuracy: 0.1429
Epoch 5/10
12/12 [=====] - 14s 1s/step - loss: 2.9712 - accuracy: 0.1755 - val_loss: 253623.9862 - val_accuracy: 0.2857
Epoch 6/10
12/12 [=====] - 14s 1s/step - loss: 2.9880 - accuracy: 0.1622 - val_loss: 17886.1543 - val_accuracy: 0.1429
Epoch 7/10
12/12 [=====] - 14s 1s/step - loss: 2.8311 - accuracy: 0.1489 - val_loss: 836.5386 - val_accuracy: 0.80000000
Epoch 8/10
12/12 [=====] - 14s 1s/step - loss: 2.4020 - accuracy: 0.1941 - val_loss: 18529.5038 - val_accuracy: 0.1429
Epoch 9/10
12/12 [=====] - 14s 1s/step - loss: 2.2347 - accuracy: 0.1888 - val_loss: 31282.3652 - val_accuracy: 0.1429
Epoch 10/10
12/12 [=====] - 14s 1s/step - loss: 2.3490 - accuracy: 0.2207 - val_loss: 69.5307 - val_accuracy: 0.2857
Chorus src call backs history at 0x7cd504b0800
```

Model 4

```

block11_sepconv1_act (Act1 (None, 19, 19, 728)
viation) 0 ['add_16[0][0]']
block11_sepconv1 (Separabl (None, 19, 19, 728)
econv2D) 536536 ['block11_sepconv1_act[0][0]']
block11_sepconv1_bn (Batch (None, 19, 19, 728)
Normalization) 2912 ['block11_sepconv1[0][0]']
block11_sepconv2_act (Act1 (None, 19, 19, 728)
viation) 0 ['block11_sepconv1_bn[0][0]']
block11_sepconv2 (Separabl (None, 19, 19, 1824)
econv2D) 712824 ['block11_sepconv2_act[0][0]']
block11_sepconv2_bn (Batch (None, 19, 19, 1824)
Normalization) 4896 ['block11_sepconv2[0][0]']
conv2d_97 (Conv2D) (None, 18, 18, 1824) 745472 ['add_18[0][0]']
block11_pool (MaxPooling2D (None, 18, 18, 1824)
) 0 ['block11_sepconv2_bn[0][0]']
batch_normalization_57 (Ba (None, 18, 18, 1824)
tchNormalization) 4896 ['conv2d_97[0][0]']
add_11 (Add) (None, 18, 18, 1824) 0 ['block11_pool[0][0]',
'batch_normalization_57[0][0]']

block14_sepconv1 (Separabl (None, 18, 18, 1536)
econv2D) 1182088 ['add_11[0][0]']
block14_sepconv1_bn (Batch (None, 18, 18, 1536)
Normalization) 6144 ['block14_sepconv1[0][0]']
block14_sepconv1_act (Act1 (None, 18, 18, 1536)
viation) 0 ['block14_sepconv1_bn[0][0]']
block14_sepconv2 (Separabl (None, 18, 18, 2048)
econv2D) 3159552 ['block14_sepconv1_act[0][0]']
block14_sepconv2_bn (Batch (None, 18, 18, 2048)
Normalization) 8192 ['block14_sepconv2[0][0]']
block14_sepconv2_act (Act1 (None, 18, 18, 2048)
viation) 0 ['block14_sepconv2_bn[0][0]']
flatten_3 (Flatten) (None, 204800) 0 ['block14_sepconv2_act[0][0]']
dense_3 (Dense) (None, 8) 1638400 ['flatten_3[0][0]']

Total params: 22495808 (85.83 MB)
Trainable params: 1638400 (6.25 MB)
Non-trainable params: 20857408 (79.58 MB)

```

```

ception.fit(train_generator, validation_data = test_generator, epochs=10 )

Epoch 1/10
1/12 [=====] - 29s 2s/step - loss: 1.8818 - accuracy: 0.9411 - val_loss: 0.8886e+00 - val_accuracy: 1.0000
Epoch 2/10
1/12 [=====] - 13s 1s/step - loss: 0.2874 - accuracy: 0.9814 - val_loss: 0.4364 - val_accuracy: 1.0000
Epoch 3/10
1/12 [=====] - 13s 1s/step - loss: 0.1984 - accuracy: 0.9814 - val_loss: 2.8977 - val_accuracy: 0.8571
Epoch 4/10
1/12 [=====] - 12s 1s/step - loss: 0.2354 - accuracy: 0.9814 - val_loss: 0.8886e+00 - val_accuracy: 1.0000
Epoch 5/10
1/12 [=====] - 13s 1s/step - loss: 0.1156 - accuracy: 0.9947 - val_loss: 0.8886e+00 - val_accuracy: 1.0000
Epoch 6/10
1/12 [=====] - 13s 1s/step - loss: 0.8178 - accuracy: 0.9947 - val_loss: 0.8886e+00 - val_accuracy: 1.0000
Epoch 7/10
1/12 [=====] - 12s 1s/step - loss: 0.8562 - accuracy: 0.9928 - val_loss: 0.8886e+00 - val_accuracy: 1.0000
Epoch 8/10
1/12 [=====] - 13s 1s/step - loss: 0.8845 - accuracy: 0.9973 - val_loss: 8.5149e-08 - val_accuracy: 1.0000
Epoch 9/10
1/12 [=====] - 13s 1s/step - loss: 0.8892 - accuracy: 0.9973 - val_loss: 1.7830e-08 - val_accuracy: 1.0000
Epoch 10/10
1/12 [=====] - 12s 1s/step - loss: 0.8814 - accuracy: 1.0000 - val_loss: 3.4806e-08 - val_accuracy: 1.0000
Epoch 10: val_loss: 3.4806e-08

```