

Model Development Phase Template

Date	23 fed 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	<pre> Model: "model" 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) 590080 block3_conv3 (Conv2D) (None, 56, 56, 256) 590080 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) </pre>	<pre> vgg16.fit(train_generator, validation_data = test_generator, epochs=10) Epoch 1/10 1/12 [=====] - 27s 1s/step - loss: 2.2112 - accuracy: 0.2580 - val_loss: 1.4655 - val_accuracy: 0.4286 Epoch 2/10 1/12 [=====] - 9s 747ms/step - loss: 1.2545 - accuracy: 0.5798 - val_loss: 0.9773 - val_accuracy: 0.7143 Epoch 3/10 1/12 [=====] - 8s 679ms/step - loss: 0.8296 - accuracy: 0.7181 - val_loss: 0.9401 - val_accuracy: 0.7143 Epoch 4/10 1/12 [=====] - 10s 830ms/step - loss: 0.6643 - accuracy: 0.7686 - val_loss: 0.6109 - val_accuracy: 0.8571 Epoch 5/10 1/12 [=====] - 10s 845ms/step - loss: 0.5785 - accuracy: 0.8191 - val_loss: 0.5487 - val_accuracy: 0.8571 Epoch 6/10 1/12 [=====] - 9s 710ms/step - loss: 0.4333 - accuracy: 0.8777 - val_loss: 0.2663 - val_accuracy: 0.8571 Epoch 7/10 1/12 [=====] - 10s 800ms/step - loss: 0.4174 - accuracy: 0.9043 - val_loss: 0.2756 - val_accuracy: 1.0000 Epoch 8/10 1/12 [=====] - 10s 838ms/step - loss: 0.3417 - accuracy: 0.8989 - val_loss: 0.2725 - val_accuracy: 0.8571 Epoch 9/10 1/12 [=====] - 8s 682ms/step - loss: 0.3489 - accuracy: 0.9069 - val_loss: 0.1049 - val_accuracy: 1.0000 Epoch 10/10 1/12 [=====] - 9s 683ms/step - loss: 0.2907 - accuracy: 0.9202 - val_loss: 0.1160 - val_accuracy: 1.0000 </pre>

Model 2

```

conv5_block2_2_conv (Conv2 (None, 7, 7, 512)      2359888 ['conv5_block2_2_relu[0][0]']
)
conv5_block2_2_bn (BatchMo (None, 7, 7, 512)      2048 ['conv5_block2_2_conv[0][0]']
)realization
conv5_block2_2_relu (Activ (None, 7, 7, 512)      0 ['conv5_block2_2_im[0][0]'])
)
conv5_block2_3_conv (Conv2 (None, 7, 7, 2048)     1858624 ['conv5_block2_3_relu[0][0]']
)
conv5_block2_3_bn (BatchMo (None, 7, 7, 2048)     8102 ['conv5_block2_3_conv[0][0]']
)realization
conv5_block2_3_add (Add) (None, 7, 7, 2048)      0 ['conv5_block2_out[0][0]', 'conv5_block2_3_im[0][0]']
)
conv5_block2_out (Activati (None, 7, 7, 2048)     0 ['conv5_block2_out[0][0]']
)
conv5_block3_1_conv (Conv2 (None, 7, 7, 512)      1849888 ['conv5_block3_1_conv[0][0]']
)
conv5_block3_1_bn (BatchMo (None, 7, 7, 512)      2048 ['conv5_block3_1_im[0][0]']
)realization
conv5_block3_1_relu (Activ (None, 7, 7, 512)      0 ['conv5_block3_1_im[0][0]'])
)
conv5_block3_2_conv (Conv2 (None, 7, 7, 512)      2359888 ['conv5_block3_2_relu[0][0]']
)
conv5_block3_2_bn (BatchMo (None, 7, 7, 512)      2048 ['conv5_block3_2_conv[0][0]']
)realization
conv5_block3_2_relu (Activ (None, 7, 7, 512)      0 ['conv5_block3_2_im[0][0]'])
)
conv5_block3_3_conv (Conv2 (None, 7, 7, 2048)     1858624 ['conv5_block3_3_relu[0][0]']
)
conv5_block3_3_bn (BatchMo (None, 7, 7, 2048)     8102 ['conv5_block3_3_conv[0][0]']
)realization
conv5_block3_3_add (Add) (None, 7, 7, 2048)      0 ['conv5_block3_out[0][0]', 'conv5_block3_3_im[0][0]']
)
conv5_block3_out (Activati (None, 7, 7, 2048)     0 ['conv5_block3_add[0][0]']
)
flatten_1 (Flatten) (None, 108352)      0 ['conv5_block3_out[0][0]']
)
dense_3 (Dense) (None, 8)      802824 ['flatten_1[0][0]']

total params: 2419636 (93.04 MB)
Trainable params: 802824 (3.06 MB)

```

```

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

Epoch 1/10
1/12 [=====] - 17s 941ms/step - loss: 8.6675 - accuracy: 0.1436 - val_loss: 6.0575 - val_accuracy: 0.1429
Epoch 2/10
1/12 [=====] - 8s 647ms/step - loss: 6.9999 - accuracy: 0.1356 - val_loss: 3.4116 - val_accuracy: 0.4286
Epoch 3/10
1/12 [=====] - 8s 630ms/step - loss: 4.2426 - accuracy: 0.1862 - val_loss: 2.2663 - val_accuracy: 0.1429
Epoch 4/10
1/12 [=====] - 9s 778ms/step - loss: 2.8612 - accuracy: 0.2207 - val_loss: 2.5258 - val_accuracy: 0.2857
Epoch 5/10
1/12 [=====] - 9s 750ms/step - loss: 2.5177 - accuracy: 0.2540 - val_loss: 1.5863 - val_accuracy: 0.2857
Epoch 6/10
1/12 [=====] - 8s 652ms/step - loss: 2.2771 - accuracy: 0.2848 - val_loss: 1.5130 - val_accuracy: 0.5714
Epoch 7/10
1/12 [=====] - 9s 774ms/step - loss: 2.1271 - accuracy: 0.2580 - val_loss: 1.4664 - val_accuracy: 0.4286
Epoch 8/10
1/12 [=====] - 9s 774ms/step - loss: 2.0697 - accuracy: 0.2606 - val_loss: 1.5892 - val_accuracy: 0.4286
Epoch 9/10
1/12 [=====] - 8s 640ms/step - loss: 1.9804 - accuracy: 0.2926 - val_loss: 1.5387 - val_accuracy: 0.4286
Epoch 10/10
1/12 [=====] - 9s 760ms/step - loss: 2.7414 - accuracy: 0.1835 - val_loss: 2.1361 - val_accuracy: 0.4286
keras.callbacks.History at 0x7edc588fe900

```

Model 3

```

inception.summary()
batch_normalization_87 (Ba (None, 8, 8, 384)      1152 ['conv2d_87[0][0]']
)tcNormalizatio
batch_normalization_88 (Ba (None, 8, 8, 384)      1152 ['conv2d_88[0][0]']
)tcNormalizatio
batch_normalization_91 (Ba (None, 8, 8, 384)      1152 ['conv2d_91[0][0]']
)tcNormalizatio
batch_normalization_92 (Ba (None, 8, 8, 384)      1152 ['conv2d_92[0][0]']
)tcNormalizatio
conv2d_93 (Conv2D) (None, 8, 8, 192)      393216 ['average_pooling2d_93[0][0]']
batch_normalization_95 (Ba (None, 8, 8, 328)      968 ['conv2d_95[0][0]']
)tcNormalizatio
activation_87 (Activation) (None, 8, 8, 384)      0 ['batch_normalization_97[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 (Ba (None, 8, 8, 192)      576 ['conv2d_93[0][0]']
)tcNormalizatio
activation_85 (Activation) (None, 8, 8, 328)      0 ['batch_normalization_95[0][0]
']
mixed9_3 (Concatenate) (None, 8, 8, 768)      0 ['activation_97[0][0]', 'activation_98[0][0]
')
concatenate_1 (Concatenate) (None, 8, 8, 768)      0 ['batch_normalization_91[0][0]', 'activation_95[0][0]
')
activation_93 (Activation) (None, 8, 8, 192)      0 ['activation_91[0][0]', 'activation_93[0][0]
']
mixed10 (Concatenate) (None, 8, 8, 2048)      0 ['activation_88[0][0]', 'mixed10_1[0][0]', 'activation_97[0][0]', 'activation_99[0][0]
']
flatten_2 (Flatten) (None, 134972)      0 ['mixed10[0][0]']
dense_2 (Dense) (None, 8)      1048584 ['flatten_2[0][0]']

total params: 22851368 (87.17 MB)
Trainable params: 22816936 (87.04 MB)
Non-trainable params: 36432 (134.50 KB)

```

```

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

Epoch 1/10
1/12 [=====] - 74s 2s/step - loss: 18.1741 - accuracy: 0.2128 - val_loss: 18216.6914 - val_accuracy: 0.1429
Epoch 2/10
1/12 [=====] - 14s 1s/step - loss: 8.7789 - accuracy: 0.1941 - val_loss: 118563.7734 - val_accuracy: 0.3429
Epoch 3/10
1/12 [=====] - 14s 1s/step - loss: 3.5277 - accuracy: 0.2181 - val_loss: 748522.1258 - val_accuracy: 0.1429
Epoch 4/10
1/12 [=====] - 14s 1s/step - loss: 3.1899 - accuracy: 0.1889 - val_loss: 104693.8594 - val_accuracy: 0.1429
Epoch 5/10
1/12 [=====] - 14s 1s/step - loss: 2.9722 - accuracy: 0.1755 - val_loss: 253621.9862 - val_accuracy: 0.2857
Epoch 6/10
1/12 [=====] - 14s 1s/step - loss: 2.9880 - accuracy: 0.1622 - val_loss: 17096.1541 - val_accuracy: 0.1429
Epoch 7/10
1/12 [=====] - 14s 1s/step - loss: 2.8311 - accuracy: 0.1489 - val_loss: 836.5386 - val_accuracy: 0.8000e+00
Epoch 8/10
1/12 [=====] - 14s 1s/step - loss: 2.4029 - accuracy: 0.1941 - val_loss: 18629.5938 - val_accuracy: 0.1429
Epoch 9/10
1/12 [=====] - 14s 1s/step - loss: 2.2140 - accuracy: 0.1888 - val_loss: 3182.3652 - val_accuracy: 0.1429
Epoch 10/10
1/12 [=====] - 14s 1s/step - loss: 2.3490 - accuracy: 0.2207 - val_loss: 69.5307 - val_accuracy: 0.2857
keras.callbacks.History at 0x7edc588fe900

```

Model 4

```

block13_sepconv1_act (Acti (None, 19, 19, 728)      0      ['add_10[0][0]']
vation)
block13_sepconv1 (Separabl (None, 19, 19, 728)    536536  ['block13_sepconv1_act[0][0]']
etConv2D)
block13_sepconv1_bn (Batch (None, 19, 19, 728)     2912   ['block13_sepconv1[0][0]']
Normalization)
block13_sepconv2_act (Acti (None, 19, 19, 728)      0      ['block13_sepconv2_bn[0][0]']
etConv2D)
block13_sepconv2 (Separabl (None, 19, 19, 1024)    752824  ['block13_sepconv2_act[0][0]']
etConv2D)
block13_sepconv2_bn (Batch (None, 19, 19, 1024)    4086   ['block13_sepconv2[0][0]']
Normalization)
conv2d_97 (Conv2D (None, 10, 10, 1024)           745472  ['add_10[0][0]']
)
block13_pool (MaxPooling2D (None, 10, 10, 1024)    0      ['block13_sepconv2_bn[0][0]']
)
batch_normalization_97 (Ba (None, 10, 10, 1024)    4086   ['conv2d_97[0][0]']
tNormalization)
add_11 (Add) (None, 10, 10, 1024)                 0      ['block13_pool[0][0]']
)
block14_sepconv1 (Separabl (None, 10, 10, 1536)    1582080 ['add_11[0][0]']
etConv2D)
block14_sepconv1_bn (Batch (None, 10, 10, 1536)   6344   ['block14_sepconv1[0][0]']
Normalization)
block14_sepconv1_act (Acti (None, 10, 10, 1536)    0      ['block14_sepconv1_bn[0][0]']
etConv2D)
block14_sepconv2 (Separabl (None, 10, 10, 2048)   3159552  ['block14_sepconv1_act[0][0]']
etConv2D)
block14_sepconv2_bn (Batch (None, 10, 10, 2048)   8192   ['block14_sepconv2[0][0]']
Normalization)
block14_sepconv2_act (Acti (None, 10, 10, 2048)    0      ['block14_sepconv2_bn[0][0]']
etConv2D)
flatten_3 (Flatten) (None, 204800)                 0      ['block14_sepconv2_act[0][0]']
)
dense_3 (Dense) (None, 8)                          1638400 ['*flatten_3[0][0]']
)
-----  

Total params: 22499888 (85.83 MB)
Trainable params: 1638400 (6.25 MB)
Non-trainable params: 20861488 (79.58 MB)
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```

```

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

Epoch 1/10
1/12 [=====] - 29s 2s/step - loss: 1.0010 - accuracy: 0.0431 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.2074 - accuracy: 0.9823 - val_loss: 0.0054 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.1984 - accuracy: 0.9834 - val_loss: 2.0977 - val_accuracy: 0.8571
Epoch 2/10
1/12 [=====] - 1s 1s/step - loss: 0.1156 - accuracy: 0.9940 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.1156 - accuracy: 0.9940 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.0870 - accuracy: 0.9950 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.0562 - accuracy: 0.9950 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.0445 - accuracy: 0.9973 - val_loss: 8.5149e-08 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.0092 - accuracy: 0.9973 - val_loss: 1.7630e-08 - val_accuracy: 1.0000
1/12 [=====] - 1s 1s/step - loss: 0.0014 - accuracy: 1.0000 - val_loss: 3.4800e-08 - val_accuracy: 1.0000
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```