

Model Development Phase Template

Date	20 July 2024
Team ID	SWTID1720433203
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) 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)</pre>	<pre>qq16.fit(train_generator, validation_data = test_generator, epochs=10) Epoch 1/10 12/12 [=====] - 27s 1s/step - loss: 2.2112 - accuracy: 0.2580 - val_loss: 1.4055 - val_accuracy: 0.4286 Epoch 2/10 12/12 [=====] - 9s 74ms/step - loss: 1.2505 - accuracy: 0.5798 - val_loss: 0.9771 - val_accuracy: 0.7143 Epoch 3/10 12/12 [=====] - 8s 67ms/step - loss: 0.8296 - accuracy: 0.7181 - val_loss: 0.9401 - val_accuracy: 0.7143 Epoch 4/10 12/12 [=====] - 10s 83ms/step - loss: 0.6643 - accuracy: 0.7686 - val_loss: 0.6189 - val_accuracy: 0.8571 Epoch 5/10 12/12 [=====] - 10s 84ms/step - loss: 0.5785 - accuracy: 0.8191 - val_loss: 0.5487 - val_accuracy: 0.8571 Epoch 6/10 12/12 [=====] - 9s 710ms/step - loss: 0.4333 - accuracy: 0.8777 - val_loss: 0.2663 - val_accuracy: 0.8571 Epoch 7/10 12/12 [=====] - 10s 80ms/step - loss: 0.4174 - accuracy: 0.9043 - val_loss: 0.2756 - val_accuracy: 1.0000 Epoch 8/10 12/12 [=====] - 10s 83ms/step - loss: 0.3417 - accuracy: 0.8989 - val_loss: 0.2725 - val_accuracy: 0.8571 Epoch 9/10 12/12 [=====] - 8s 682ms/step - loss: 0.3489 - accuracy: 0.9009 - val_loss: 0.1049 - val_accuracy: 1.0000 Epoch 10/10 12/12 [=====] - 9s 68ms/step - loss: 0.2907 - accuracy: 0.9202 - val_loss: 0.1160 - val_accuracy: 1.0000 keras.callbacks.History at 0x7dc5d4fee980</pre>
Model 2	<pre>conv5_block2_2_conv (Conv2 (None, 7, 7, 512) 2359808 ['conv5_block2_2_conv[0][0] D) realization) conv5_block2_2_bn (BatchNo (None, 7, 7, 512) 2048 ['conv5_block2_2_bn[0][0] realization) conv5_block2_2_relu (Activ (None, 7, 7, 512) 0 ['conv5_block2_2_relu[0][0] ation) conv5_block2_3_conv (Conv2 (None, 7, 7, 2048) 1850624 ['conv5_block2_3_conv[0][0] D) realization) conv5_block2_3_bn (BatchNo (None, 7, 7, 2048) 8192 ['conv5_block2_3_bn[0][0] realization) conv5_block2_3_add (Add) (None, 7, 7, 2048) 0 ['conv5_block2_3_add[0][0] realization) conv5_block2_out (Activati (None, 7, 7, 2048) 0 ['conv5_block2_out[0][0] on) conv5_block3_1_conv (Conv2 (None, 7, 7, 512) 1840888 ['conv5_block3_1_conv[0][0] D) realization) conv5_block3_1_bn (BatchNo (None, 7, 7, 512) 2048 ['conv5_block3_1_bn[0][0] realization) conv5_block3_1_relu (Activ (None, 7, 7, 512) 0 ['conv5_block3_1_relu[0][0] ation) conv5_block3_2_conv (Conv2 (None, 7, 7, 512) 2359808 ['conv5_block3_2_conv[0][0] D) realization) conv5_block3_2_bn (BatchNo (None, 7, 7, 512) 2048 ['conv5_block3_2_bn[0][0] realization) conv5_block3_2_relu (Activ (None, 7, 7, 512) 0 ['conv5_block3_2_relu[0][0] ation) conv5_block3_3_conv (Conv2 (None, 7, 7, 2048) 1850624 ['conv5_block3_3_conv[0][0] D) realization) conv5_block3_3_bn (BatchNo (None, 7, 7, 2048) 8192 ['conv5_block3_3_bn[0][0] realization) conv5_block3_3_add (Add) (None, 7, 7, 2048) 0 ['conv5_block3_3_add[0][0] realization) conv5_block3_out (Activati (None, 7, 7, 2048) 0 ['conv5_block3_out[0][0], on) 'conv5_block3_3_bn[0][0] flatten_1 (Flatten) (None, 100352) 0 ['conv5_block3_out[0][0] dense_1 (Dense) (None, 8) 802824 ['flatten_1[0][0] ===== Total params: 2410836 (93.06 MB) Trainable params: 802824 (3.06 MB)</pre>	<pre>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: 6.9575 - val_accuracy: 0.1429 Epoch 2/10 12/12 [=====] - 8s 647ms/step - loss: 6.9999 - accuracy: 0.1356 - val_loss: 3.4116 - val_accuracy: 0.4286 Epoch 3/10 12/12 [=====] - 8s 636ms/step - loss: 4.2428 - accuracy: 0.1852 - val_loss: 2.2663 - val_accuracy: 0.1429 Epoch 4/10 12/12 [=====] - 9s 778ms/step - loss: 2.8612 - accuracy: 0.2207 - val_loss: 2.5258 - val_accuracy: 0.2857 Epoch 5/10 12/12 [=====] - 9s 750ms/step - loss: 2.5177 - accuracy: 0.2340 - val_loss: 1.5863 - val_accuracy: 0.2857 Epoch 6/10 12/12 [=====] - 8s 652ms/step - loss: 2.2711 - accuracy: 0.2048 - val_loss: 1.5330 - val_accuracy: 0.5714 Epoch 7/10 12/12 [=====] - 9s 774ms/step - loss: 2.2721 - accuracy: 0.2580 - val_loss: 1.4668 - val_accuracy: 0.4286 Epoch 8/10 12/12 [=====] - 9s 776ms/step - loss: 2.0637 - accuracy: 0.2606 - val_loss: 1.5872 - val_accuracy: 0.4286 Epoch 9/10 12/12 [=====] - 8s 646ms/step - loss: 1.9804 - accuracy: 0.2926 - val_loss: 1.5187 - val_accuracy: 0.4286 Epoch 10/10 12/12 [=====] - 9s 766ms/step - loss: 2.7814 - accuracy: 0.1835 - val_loss: 2.1361 - val_accuracy: 0.4286 keras.callbacks.History at 0x7dc5d4fee980</pre>

Model 3

```

inception.summary()
batch_normalization_87 (Batch Normalization) (None, 8, 8, 184) 1152 ['conv2d_87[0][0]']
conv2d_88 (Conv2D) (None, 8, 8, 184) 1152 ['conv2d_88[0][0]']
batch_normalization_88 (Batch Normalization) (None, 8, 8, 184) 1152 ['conv2d_88[0][0]']
conv2d_89 (Conv2D) (None, 8, 8, 184) 1152 ['conv2d_89[0][0]']
batch_normalization_89 (Batch Normalization) (None, 8, 8, 184) 1152 ['conv2d_89[0][0]']
conv2d_90 (Conv2D) (None, 8, 8, 192) 393216 ['average_pooling2d_8[0][0]']
batch_normalization_90 (Batch Normalization) (None, 8, 8, 192) 393216 ['conv2d_90[0][0]']
activation_87 (Activation) (None, 8, 8, 184) 0 ['batch_normalization_87[0][0]']
activation_88 (Activation) (None, 8, 8, 184) 0 ['batch_normalization_88[0][0]']
activation_89 (Activation) (None, 8, 8, 184) 0 ['batch_normalization_89[0][0]']
activation_90 (Activation) (None, 8, 8, 184) 0 ['batch_normalization_90[0][0]']
batch_normalization_91 (Batch Normalization) (None, 8, 8, 192) 576 ['conv2d_91[0][0]']
activation_91 (Activation) (None, 8, 8, 192) 0 ['batch_normalization_91[0][0]']
mixed_9 (Concatenate) (None, 8, 8, 768) 0 ['activation_87[0][0]', 'activation_88[0][0]', 'activation_89[0][0]', 'activation_90[0][0]']
concatenate_3 (Concatenate) (None, 8, 8, 768) 0 ['activation_91[0][0]', 'activation_90[0][0]']
activation_92 (Activation) (None, 8, 8, 192) 0 ['batch_normalization_92[0][0]']
mixed10 (Concatenate) (None, 8, 8, 2048) 0 ['activation_92[0][0]', 'mixed_9[0][0]', 'concatenate_3[0][0]', 'activation_93[0][0]']
flatten_2 (Flatten) (None, 131072) 0 ['mixed10[0][0]']
dense_2 (Dense) (None, 8) 1848584 ['flatten_2[0][0]']

Total params: 22851368 (87.17 MB)
Trainable params: 22816936 (87.06 MB)
Non-trainable params: 34432 (134.58 KB)

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```

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

Epoch 1/10
12/12 [=====] - 74s 2s/step - loss: 18.1741 - accuracy: 0.2328 - val_loss: 19216.6814 - val_accuracy: 0.1429
Epoch 2/10
12/12 [=====] - 14s 1s/step - loss: 8.7789 - accuracy: 0.1941 - val_loss: 118563.7734 - val_accuracy: 0.1429
Epoch 3/10
12/12 [=====] - 14s 1s/step - loss: 3.5277 - accuracy: 0.2181 - val_loss: 74832.1358 - val_accuracy: 0.1429
Epoch 4/10
12/12 [=====] - 14s 1s/step - loss: 3.1059 - accuracy: 0.1889 - val_loss: 136493.8534 - val_accuracy: 0.1429
Epoch 5/10
12/12 [=====] - 14s 1s/step - loss: 2.9712 - accuracy: 0.1755 - val_loss: 253621.9862 - val_accuracy: 0.2857
Epoch 6/10
12/12 [=====] - 14s 1s/step - loss: 2.9888 - 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: 826.5386 - val_accuracy: 0.0000e+00
Epoch 8/10
12/12 [=====] - 14s 1s/step - loss: 2.4829 - accuracy: 0.1941 - val_loss: 18529.5838 - 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: 2.3408 - accuracy: 0.2287 - val_loss: 69.4367 - val_accuracy: 0.2857
inception.save('inception_history.h5')

```

Model 4

```

block11_sepconv1_act (Activation) (None, 19, 19, 728) 0 ['add_3[0][0]']
block11_sepconv1 (Separable Conv2D) (None, 19, 19, 728) 536536 ['block11_sepconv1_act[0][0]']
block11_sepconv1_bn (Batch Normalization) (None, 19, 19, 728) 2012 ['block11_sepconv1[0][0]']
block11_sepconv2_act (Activation) (None, 19, 19, 728) 0 ['block11_sepconv1_bn[0][0]']
block11_sepconv2 (Separable Conv2D) (None, 19, 19, 1824) 752824 ['block11_sepconv2_act[0][0]']
block11_sepconv2_bn (Batch Normalization) (None, 19, 19, 1824) 4096 ['block11_sepconv2[0][0]']
conv2d_97 (Conv2D) (None, 18, 18, 1824) 745472 ['add_3[0][0]']
block11_pool (MaxPooling2D) (None, 18, 18, 1824) 0 ['block11_sepconv2_bn[0][0]']
batch_normalization_97 (Batch Normalization) (None, 18, 18, 1824) 4096 ['conv2d_97[0][0]']
add_3 (Add) (None, 18, 18, 1824) 0 ['block11_pool[0][0]', 'batch_normalization_97[0][0]']
block14_sepconv1 (Separable Conv2D) (None, 18, 18, 1536) 1582088 ['add_3[0][0]']
block14_sepconv1_bn (Batch Normalization) (None, 18, 18, 1536) 6344 ['block14_sepconv1[0][0]']
block14_sepconv2_act (Activation) (None, 18, 18, 1536) 0 ['block14_sepconv1_bn[0][0]']
block14_sepconv2 (Separable Conv2D) (None, 18, 18, 2048) 3159552 ['block14_sepconv2_act[0][0]']
block14_sepconv2_bn (Batch Normalization) (None, 18, 18, 2048) 8192 ['block14_sepconv2[0][0]']
block14_sepconv3_act (Activation) (None, 18, 18, 2048) 0 ['block14_sepconv2_bn[0][0]']
flatten_3 (Flatten) (None, 204800) 0 ['block14_sepconv3_act[0][0]']
dense_3 (Dense) (None, 8) 1638408 ['flatten_3[0][0]']

Total params: 22499888 (85.83 MB)
Trainable params: 1638408 (6.25 MB)
Non-trainable params: 20861408 (79.58 MB)

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```

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

Epoch 1/10
12/12 [=====] - 27s 2s/step - loss: 1.0818 - accuracy: 0.8431 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 2/10
12/12 [=====] - 13s 1s/step - loss: 0.2874 - accuracy: 0.9814 - val_loss: 0.0364 - val_accuracy: 1.0000
Epoch 3/10
12/12 [=====] - 13s 1s/step - loss: 0.1984 - accuracy: 0.9814 - val_loss: 2.8977 - val_accuracy: 0.9571
Epoch 4/10
12/12 [=====] - 13s 1s/step - loss: 0.2354 - accuracy: 0.9814 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 5/10
12/12 [=====] - 13s 1s/step - loss: 0.1156 - accuracy: 0.9947 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 6/10
12/12 [=====] - 13s 1s/step - loss: 0.0378 - accuracy: 0.9947 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 7/10
12/12 [=====] - 12s 1s/step - loss: 0.0562 - accuracy: 0.9928 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 8/10
12/12 [=====] - 13s 1s/step - loss: 0.0045 - accuracy: 0.9973 - val_loss: 8.5140e-08 - val_accuracy: 1.0000
Epoch 9/10
12/12 [=====] - 13s 1s/step - loss: 0.0052 - accuracy: 0.9973 - val_loss: 1.7030e-08 - val_accuracy: 1.0000
Epoch 10/10
12/12 [=====] - 13s 1s/step - loss: 0.0014 - accuracy: 1.0000 - val_loss: 3.4860e-08 - val_accuracy: 1.0000
inception.save('inception_history.h5')

```