

Model Development Phase Template

Date	11 July 2024
Team ID	SWTID1720011518
Project Title	WCE curated Colon Disease Classification using Deep 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:

```
[ ] for layer in vgg.layers:
    layer.trainable = False

[ ] x = Flatten()(vgg.output)

[ ] output = Dense(4,activation = "softmax")(x)

[ ] vgg16 = Model(vgg.input , output)

[ ] vgg16.summary()

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
```

```
[ ] vgg16.compile(optimizer = "adam",loss = "categorical_crossentropy",metrics = ["accuracy"])

[ ] history = vgg16.fit(train , validation_data= test,epochs = 5)

Epoch 1/5
160/160 [=====] - 107s 622ms/step - loss: 0.2567 - accuracy: 0.9134 - val_loss: 0.1309 - val_accuracy: 0.9469
Epoch 2/5
160/160 [=====] - 100s 624ms/step - loss: 0.0870 - accuracy: 0.9688 - val_loss: 0.0259 - val_accuracy: 0.9912
Epoch 3/5
160/160 [=====] - 100s 628ms/step - loss: 0.0551 - accuracy: 0.9806 - val_loss: 0.1200 - val_accuracy: 0.9481
Epoch 4/5
160/160 [=====] - 82s 514ms/step - loss: 0.0398 - accuracy: 0.9847 - val_loss: 0.1132 - val_accuracy: 0.9522
Epoch 5/5
160/160 [=====] - 81s 509ms/step - loss: 0.0272 - accuracy: 0.9909 - val_loss: 0.0190 - val_accuracy: 0.9937
```

Resnet50:

```

for layer in resnet50.layers:
    layer.trainable = False

[ ] x1 = Flatten()(resnet50.output)

[ ] output = Dense(4,activation = "softmax")(x1)

[ ] resnet = Model(resnet50.input , output)

[ ] resnet.summary()

conv5_block2_2_bn (BatchNo (None, 7, 7, 512)      2048      ['conv5_block2_2_conv[0][0]']
rmalization)

conv5_block2_2_relu (Activ (None, 7, 7, 512)      0          ['conv5_block2_2_bn[0][0]']
ation)

conv5_block2_3_conv (conv2 (None, 7, 7, 2048)     1050624    ['conv5_block2_2_relu[0][0]']
D)

conv5_block2_3_bn (BatchNo (None, 7, 7, 2048)     8192      ['conv5_block2_3_conv[0][0]']
)

[ ] resnet.compile(loss = "categorical_crossentropy", optimizer = "adam" , metrics = ["accuracy"])

history3 = resnet.fit(train , validation_data = test , epochs = 5)

Epoch 1/5
160/160 [=====] - 81s 509ms/step - loss: 0.4264 - accuracy: 0.8394 - val_loss: 0.3856 - val_accuracy: 0.8422
Epoch 2/5
160/160 [=====] - 81s 504ms/step - loss: 0.5056 - accuracy: 0.8156 - val_loss: 0.3810 - val_accuracy: 0.8481
Epoch 3/5
160/160 [=====] - 80s 500ms/step - loss: 0.5100 - accuracy: 0.8231 - val_loss: 0.3660 - val_accuracy: 0.8537
Epoch 4/5
160/160 [=====] - 81s 506ms/step - loss: 0.3765 - accuracy: 0.8594 - val_loss: 0.2215 - val_accuracy: 0.9191
Epoch 5/5
160/160 [=====] - 80s 500ms/step - loss: 0.3833 - accuracy: 0.8625 - val_loss: 0.2326 - val_accuracy: 0.9047

```

InceptionV3:

```

[ ] for layer in inception_v3.layers:
    layer.trainable = False

[ ] x3 = Flatten()(inception_v3.output)

[ ] output3 = Dense(4,activation = "softmax")(x3)

[ ] inception = Model(inception_v3.input, output3)

inception.summary()

conv2d_88 (Conv2D)      (None, 8, 8, 384)      442368      ['activation_86[0][0]']
conv2d_91 (Conv2D)      (None, 8, 8, 384)      442368      ['activation_90[0][0]']
conv2d_92 (Conv2D)      (None, 8, 8, 384)      442368      ['activation_90[0][0]']
average_pooling2d_8 (Avera (None, 8, 8, 2048)     0          ['mixed9[0][0]']
gePooling2D)
conv2d_85 (Conv2D)      (None, 8, 8, 320)      655360      ['mixed9[0][0]']
batch_normalization_87 (Ba (None, 8, 8, 384)      1152      ['conv2d_87[0][0]']
tchNormaliza

[ ] inception.compile(loss = "categorical_crossentropy", optimizer = "adam", metrics = ["accuracy"])

history4 = inception.fit(train, validation_data = test, epochs = 5)

Epoch 1/5
160/160 [=====] - 106s 614ms/step - loss: 2.6529 - accuracy: 0.8931 - val_loss: 0.8691 - val_accuracy: 0.9375
Epoch 2/5
160/160 [=====] - 92s 577ms/step - loss: 0.5101 - accuracy: 0.9691 - val_loss: 0.6682 - val_accuracy: 0.9525
Epoch 3/5
160/160 [=====] - 91s 564ms/step - loss: 0.3904 - accuracy: 0.9747 - val_loss: 1.3684 - val_accuracy: 0.9362
Epoch 4/5
160/160 [=====] - 91s 566ms/step - loss: 0.4131 - accuracy: 0.9778 - val_loss: 0.6467 - val_accuracy: 0.9675
Epoch 5/5
160/160 [=====] - 90s 561ms/step - loss: 0.2585 - accuracy: 0.9850 - val_loss: 4.9814 - val_accuracy: 0.8537

```

Model Validation and Evaluation Report (5 marks):

Model	Summary	Training and Validation Performance Metrics
VGG16	<pre> vgg.summary() Model: "vgg16" 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 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, 4) 100356 Total params: 14815044 (56.51 MB) Trainable params: 100356 (392.02 KB) Non-trainable params: 14714688 (56.13 MB) </pre>	<pre> History = vgg16.fit(train, validation_data=test, epochs = 5) Epoch 1/5 100/100 [-----] - 107s 628ms/step - loss: 0.2567 - accuracy: 0.9134 - val_loss: 0.1389 - val_accuracy: 0.9469 Epoch 2/5 100/100 [-----] - 100s 624ms/step - loss: 0.0870 - accuracy: 0.9688 - val_loss: 0.0259 - val_accuracy: 0.9912 Epoch 3/5 100/100 [-----] - 100s 628ms/step - loss: 0.0751 - accuracy: 0.9806 - val_loss: 0.1200 - val_accuracy: 0.9481 Epoch 4/5 100/100 [-----] - 82s 514ms/step - loss: 0.0398 - accuracy: 0.9847 - val_loss: 0.1112 - val_accuracy: 0.9522 Epoch 5/5 100/100 [-----] - 81s 509ms/step - loss: 0.0272 - accuracy: 0.9909 - val_loss: 0.0100 - val_accuracy: 0.9917 </pre>
Resnet50	<pre> resnet.summary() conv5_block2_2_bn (BatchNorm (None, 7, 7, 512) 2048 ['conv5_block2_2_conv[0][0]'] rmalization) conv5_block2_2_relu (Activ (None, 7, 7, 512) 0 ['conv5_block2_2_bn[0][0]'] ation) conv5_block2_3_conv (Conv2 (None, 7, 7, 2048) 1058624 ['conv5_block2_2_relu[0][0]'] D) conv5_block2_3_bn (BatchNorm (None, 7, 7, 2048) 8192 ['conv5_block2_3_conv[0][0]'] rmalization) conv5_block2_3_add (Add) (None, 7, 7, 2048) 0 ['conv5_block2_out[0][0]', 'conv5_block2_3_bn[0][0]'] conv5_block2_out (Activati (None, 7, 7, 2048) 0 ['conv5_block2_add[0][0]'] on) conv5_block3_1_conv (Conv2 (None, 7, 7, 512) 1049088 ['conv5_block2_out[0][0]'] D) conv5_block3_1_bn (BatchNorm (None, 7, 7, 512) 2048 ['conv5_block3_1_conv[0][0]'] rmalization) conv5_block3_1_relu (Activ (None, 7, 7, 512) 0 ['conv5_block3_1_bn[0][0]'] ation) conv5_block3_3_bn (BatchNorm (None, 7, 7, 2048) 8192 ['conv5_block3_3_conv[0][0]'] rmalization) conv5_block3_3_add (Add) (None, 7, 7, 2048) 0 ['conv5_block2_out[0][0]', 'conv5_block3_3_bn[0][0]'] conv5_block3_out (Activati (None, 7, 7, 2048) 0 ['conv5_block3_add[0][0]'] on) flatten_1 (Flatten) (None, 100352) 0 ['conv5_block3_out[0][0]'] dense_1 (Dense) (None, 4) 401412 ['flatten_1[0][0]'] Total params: 23989124 (91.51 MB) Trainable params: 401412 (1.53 MB) Non-trainable params: 23587712 (89.98 MB) </pre>	<pre> History = resnet.fit(train, validation_data = test, epochs = 5) Epoch 1/5 100/100 [-----] - 81s 509ms/step - loss: 0.4204 - accuracy: 0.8394 - val_loss: 0.3056 - val_accuracy: 0.8422 Epoch 2/5 100/100 [-----] - 81s 504ms/step - loss: 0.5456 - accuracy: 0.8156 - val_loss: 0.3810 - val_accuracy: 0.8481 Epoch 3/5 100/100 [-----] - 80s 500ms/step - loss: 0.5100 - accuracy: 0.8231 - val_loss: 0.3600 - val_accuracy: 0.8537 Epoch 4/5 100/100 [-----] - 81s 506ms/step - loss: 0.3705 - accuracy: 0.8594 - val_loss: 0.2215 - val_accuracy: 0.9191 Epoch 5/5 100/100 [-----] - 80s 500ms/step - loss: 0.3833 - accuracy: 0.8625 - val_loss: 0.2120 - val_accuracy: 0.9047 </pre>

Inception V3

```
inception.summary()
batch_normalization_87 (Batch Normalization) (None, 8, 8, 384) 1152 ["conv2d_87[0][0]"]
batch_normalization_88 (Batch Normalization) (None, 8, 8, 384) 1152 ["conv2d_88[0][0]"]
batch_normalization_91 (Batch Normalization) (None, 8, 8, 384) 1152 ["conv2d_91[0][0]"]
batch_normalization_92 (Batch Normalization) (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 (Batch Normalization) (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_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_4 (Dense) (None, 4) 524292 ["flatten_2[0][0]"]

Total params: 22327876 (85.17 MB)
Trainable params: 524292 (2.00 MB)
Non-trainable params: 21803584 (83.17 MB)
```

```
history4 = inception.fit(train, validation_data = test, epochs = 5)

Epoch 1/5
100/100 [=====] - loss: 2.6529 - accuracy: 0.8091 - val_loss: 0.8091 - val_accuracy: 0.9312
Epoch 2/5
100/100 [=====] - loss: 0.5181 - accuracy: 0.9691 - val_loss: 0.6682 - val_accuracy: 0.9525
Epoch 3/5
100/100 [=====] - loss: 0.3984 - accuracy: 0.9747 - val_loss: 1.3684 - val_accuracy: 0.9362
Epoch 4/5
100/100 [=====] - loss: 0.4131 - accuracy: 0.9778 - val_loss: 0.6467 - val_accuracy: 0.9675
Epoch 5/5
100/100 [=====] - loss: 0.2585 - accuracy: 0.9858 - val_loss: 4.9814 - val_accuracy: 0.8537
```