Model Development Phase Template

Date	4 July 2024
Team ID	SWTID1720097611
Project Title	CovidVision: Advanced COVID-19 Detection from Lung X-rays with 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):

Model 1 (VGG16):

```
my_callbacks = [EarlyStopping(patience=6)]

vgg16.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])
vgg16.fit(train_data, epochs=20, validation_data=test_data, steps_per_epoch=len(train_data)//16,
          validation_steps=len(test_data)//16, callbacks=my_callbacks)
```

Model 2 (ResNet50):

```
resnet50.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])

my_callbacks = [EarlyStopping(patience=6)]

resnet50.fit(train_data,epochs=15,validation_data=test_data,steps_per_epoch=len(train_data)//16,
             validation_steps=len(test_data)//16, callbacks=my_callbacks)
```

Model 3 (InceptionV3):

```
inceptionV3.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])

my_callbacks = [EarlyStopping(patience=6)]
inceptionV3.fit(train_data,epochs=20,validation_data=test_data , steps_per_epoch=len(train_data)//16,
                validation_steps=len(test_data)//16, callbacks=my_callbacks)
```

Model 4 (Xception):

```
xception.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])

my_callbacks = [EarlyStopping(patience=6)]
xception.fit(train_data,epochs=15,validation_data=test_data , steps_per_epoch=len(train_data)//16,
             validation_steps=len(test_data)//16, callbacks=my_callbacks)
```

Model Validation and Evaluation Report (5 marks):

Model	Summary	Training and Validation Performance Metrics
VGG16	`vgg = VGG16(input_shape=(224,224,3),include_top=False)` `for layers in vgg.layers:` `  layers.trainable = False` `x = Flatten()(vgg.output)` `x = Dense(256,activation='relu')(x)` `output = Dense(4,activation='softmax')(x)` `vgg16= Model(vgg.input,output)` `vgg16.summary()`	Epoch 1/20 12/12 [==========] - 352s 29s/step - loss: 3.6223 - accuracy: 0.4245 - val_loss: 1.0858 - val_accuracy: 0.6458 Epoch 2/20 12/12 [==========] - 345s 29s/step - loss: 0.8410 - accuracy: 0.6562 - val_loss: 0.6532 - val_accuracy: 0.7708 Epoch 3/20 12/12 [==========] - 334s 28s/step - loss: 0.6660 - accuracy: 0.7578 - val_loss: 0.7234 - val_accuracy: 0.7500 Epoch 4/20 12/12 [==========] - 339s 29s/step - loss: 0.5878 - accuracy: 0.7812 - val_loss: 0.5618 - val_accuracy: 0.7708 Epoch 5/20 12/12 [==========] - 320s 27s/step - loss: 0.5933 - accuracy: 0.7552 - val_loss: 0.5698 - val_accuracy: 0.8021 Epoch 6/20 12/12 [==========] - 335s 28s/step - loss: 0.5112 - accuracy: 0.7786 - val_loss: 0.4295 - val_accuracy: 0.8646 Epoch 7/20 12/12 [==========] - 336s 28s/step - loss: 0.5392 - accuracy: 0.7630 - val_loss: 0.3988 - val_accuracy: 0.8542 Epoch 8/20 12/12 [==========] - 315s 28s/step - loss: 0.4660 - accuracy: 0.8287 - val_loss: 0.4610 - val_accuracy: 0.8438 Epoch 9/20 12/12 [==========] - 334s 28s/step - loss: 0.4920 - accuracy: 0.8021 - val_loss: 0.5035 - val_accuracy: 0.8542 Epoch 10/20 12/12 [==========] - 339s 29s/step - loss: 0.4743 - accuracy: 0.8203 - val_loss: 0.4067 - val_accuracy: 0.8333 Epoch 11/20 12/12 [==========] - 334s 28s/step - loss: 0.4811 - accuracy: 0.7891 - val_loss: 0.4145 - val_accuracy: 0.8333 Epoch 12/20 12/12 [==========] - 298s 25s/step - loss: 0.5010 - accuracy: 0.8062 - val_loss: 0.3838 - val_accuracy: 0.8542 Epoch 13/20 12/12 [==========] - 313s 27s/step - loss: 0.5635 - accuracy: 0.7734 - val_loss: 0.4627 - val_accuracy: 0.8125 Epoch 14/20 12/12 [==========] - 333s 28s/step - loss: 0.4092 - accuracy: 0.8568 - val_loss: 0.4268 - val_accuracy: 0.8333 Epoch 15/20 12/12 [==========] - 332s 28s/step - loss: 0.4094 - accuracy: 0.8620 - val_loss: 0.5908 - val_accuracy: 0.7500 Epoch 16/20 12/12 [==========] - 332s 28s/step - loss: 0.3832 - accuracy: 0.8776 - val_loss: 0.3152 - val_accuracy: 0.8854 Epoch 17/20 12/12 [==========] - 312s 26s/step - loss: 0.3281 - accuracy: 0.8958 - val_loss: 0.3650 - val_accuracy: 0.8646 Epoch 18/20 12/12 [==========] - 333s 28s/step - loss: 0.3957 - accuracy: 0.8516 - val_loss: 0.4924 - val_accuracy: 0.8229 Epoch 19/20 12/12 [==========] - 332s 28s/step - loss: 0.4734 - accuracy: 0.8255 - val_loss: 0.4065 - val_accuracy: 0.8854 Epoch 20/20 12/12 [==========] - 337s 28s/step - loss: 0.3481 - accuracy: 0.8620 - val_loss: 0.4055 - val_accuracy: 0.8542 <keras.src.callbacks.History at 0x7891868a6680>
ResNet50	`resnet= ResNet50(input_shape=(224,224,3),include_top=False)` `for layers in resnet.layers:` `  layers.trainable = False` `x=Flatten()(resnet.output)` `x=Dense(256,activation='relu')(x)` `output=Dense(4,activation='softmax')(x)` `resnet50=Model(resnet.input,output)` `resnet50.summary()`	Epoch 1/15 12/12 [==========] - 157s 13s/step - loss: 16.5380 - accuracy: 0.2917 - val_loss: 6.5168 - val_accuracy: 0.4583 Epoch 2/15 12/12 [==========] - 138s 11s/step - loss: 3.2902 - accuracy: 0.3568 - val_loss: 1.7918 - val_accuracy: 0.2812 Epoch 3/15 12/12 [==========] - 120s 10s/step - loss: 1.7814 - accuracy: 0.3750 - val_loss: 1.7131 - val_accuracy: 0.3125 Epoch 4/15 12/12 [==========] - 122s 10s/step - loss: 1.4112 - accuracy: 0.4115 - val_loss: 1.0815 - val_accuracy: 0.6042 Epoch 5/15 12/12 [==========] - 187s 11s/step - loss: 1.2343 - accuracy: 0.4583 - val_loss: 1.3304 - val_accuracy: 0.3646 Epoch 6/15 12/12 [==========] - 129s 11s/step - loss: 1.3388 - accuracy: 0.4073 - val_loss: 1.1267 - val_accuracy: 0.5938 Epoch 7/15 12/12 [==========] - 193s 17s/step - loss: 1.2891 - accuracy: 0.4740 - val_loss: 1.3216 - val_accuracy: 0.4479 Epoch 8/15 12/12 [==========] - 117s 10s/step - loss: 1.2501 - accuracy: 0.4453 - val_loss: 1.3494 - val_accuracy: 0.2083 Epoch 9/15 12/12 [==========] - 125s 10s/step - loss: 1.1740 - accuracy: 0.5000 - val_loss: 1.2248 - val_accuracy: 0.3958 Epoch 10/15 12/12 [==========] - 136s 11s/step - loss: 1.1538 - accuracy: 0.4896 - val_loss: 1.2708 - val_accuracy: 0.4271 <keras.src.callbacks.History at 0x7891a8e54ca0>

Inception	``` inception = InceptionV3(input_shape=(224,224,3),include_top=False) for layers in inception.layers: layers.trainable = False x=Flatten()(inception.output) x=Dense(256,activation='relu')(x) output=Dense(4,activation='softmax')(x) inceptionV3=Model(inception.input,output) ```	``` Epoch 1/20 12/12 [==============================] - 82s 6s/step - loss: 22.7226 - accuracy: 0.4792 - val_loss: 6.5945 - val_accuracy: 0.6042 Epoch 2/20 12/12 [==============================] - 75s 6s/step - loss: 6.2488 - accuracy: 0.6146 - val_loss: 4.6134 - val_accuracy: 0.7083 Epoch 3/20 12/12 [==============================] - 80s 7s/step - loss: 4.0873 - accuracy: 0.6901 - val_loss: 2.7736 - val_accuracy: 0.7917 Epoch 4/20 12/12 [==============================] - 82s 7s/step - loss: 4.2119 - accuracy: 0.7109 - val_loss: 3.1315 - val_accuracy: 0.6458 Epoch 5/20 12/12 [==============================] - 76s 6s/step - loss: 2.3398 - accuracy: 0.7734 - val_loss: 2.6139 - val_accuracy: 0.7604 Epoch 6/20 12/12 [==============================] - 79s 7s/step - loss: 1.8193 - accuracy: 0.7917 - val_loss: 3.0264 - val_accuracy: 0.6042 Epoch 7/20 12/12 [==============================] - 79s 7s/step - loss: 1.2109 - accuracy: 0.8281 - val_loss: 0.9765 - val_accuracy: 0.8021 Epoch 8/20 12/12 [==============================] - 81s 7s/step - loss: 1.3443 - accuracy: 0.7943 - val_loss: 1.4651 - val_accuracy: 0.8021 Epoch 9/20 12/12 [==============================] - 78s 7s/step - loss: 1.6821 - accuracy: 0.7682 - val_loss: 1.5841 - val_accuracy: 0.7604 Epoch 10/20 12/12 [==============================] - 80s 7s/step - loss: 1.9994 - accuracy: 0.7109 - val_loss: 1.0656 - val_accuracy: 0.8542 Epoch 11/20 12/12 [==============================] - 74s 6s/step - loss: 1.3287 - accuracy: 0.8464 - val_loss: 1.9983 - val_accuracy: 0.7083 Epoch 12/20 12/12 [==============================] - 79s 7s/step - loss: 1.5837 - accuracy: 0.7812 - val_loss: 1.8305 - val_accuracy: 0.7708 Epoch 13/20 12/12 [==============================] - 81s 7s/step - loss: 1.3807 - accuracy: 0.7839 - val_loss: 2.3536 - val_accuracy: 0.7292 <keras.src.callbacks.History at 0x7891868c0ee0> ```
Xception	``` xception = Xception(input_shape=(299,299,3),include_top=False) for layers in xception.layers: layers.trainable = False x=Flatten()(xception.output) x=Dense(256,activation='relu')(x) output=Dense(4,activation='softmax')(x) xception=Model(xception.input,output) xception.summary() ```	``` Epoch 1/15 12/12 [==============================] - 346s 28s/step - loss: 10.7327 - accuracy: 0.5729 - val_loss: 6.9207 - val_accuracy: 0.6458 Epoch 2/15 12/12 [==============================] - 270s 23s/step - loss: 4.7793 - accuracy: 0.7388 - val_loss: 3.3135 - val_accuracy: 0.7292 Epoch 3/15 12/12 [==============================] - 283s 24s/step - loss: 4.8017 - accuracy: 0.6979 - val_loss: 4.9188 - val_accuracy: 0.6979 Epoch 4/15 12/12 [==============================] - 253s 21s/step - loss: 3.2561 - accuracy: 0.7448 - val_loss: 2.0761 - val_accuracy: 0.7917 Epoch 5/15 12/12 [==============================] - 236s 20s/step - loss: 2.4279 - accuracy: 0.7781 - val_loss: 2.6128 - val_accuracy: 0.7917 Epoch 6/15 12/12 [==============================] - 252s 21s/step - loss: 2.3558 - accuracy: 0.7630 - val_loss: 2.4274 - val_accuracy: 0.7917 Epoch 7/15 12/12 [==============================] - 284s 24s/step - loss: 1.6635 - accuracy: 0.7865 - val_loss: 1.8533 - val_accuracy: 0.8229 Epoch 8/15 12/12 [==============================] - 287s 24s/step - loss: 1.3984 - accuracy: 0.7969 - val_loss: 2.5503 - val_accuracy: 0.7708 Epoch 9/15 12/12 [==============================] - 287s 24s/step - loss: 1.3955 - accuracy: 0.8073 - val_loss: 0.7863 - val_accuracy: 0.7812 Epoch 10/15 12/12 [==============================] - 251s 21s/step - loss: 1.1529 - accuracy: 0.8229 - val_loss: 1.3036 - val_accuracy: 0.7083 Epoch 11/15 12/12 [==============================] - 250s 21s/step - loss: 0.8218 - accuracy: 0.8203 - val_loss: 0.5705 - val_accuracy: 0.7812 Epoch 12/15 12/12 [==============================] - 284s 24s/step - loss: 0.8522 - accuracy: 0.8255 - val_loss: 1.1529 - val_accuracy: 0.7917 Epoch 13/15 12/12 [==============================] - 249s 21s/step - loss: 0.8832 - accuracy: 0.8464 - val_loss: 0.5329 - val_accuracy: 0.8021 Epoch 14/15 12/12 [==============================] - 286s 24s/step - loss: 0.8095 - accuracy: 0.8229 - val_loss: 0.7230 - val_accuracy: 0.8229 Epoch 15/15 12/12 [==============================] - 272s 23s/step - loss: 0.6069 - accuracy: 0.8708 - val_loss: 0.9447 - val_accuracy: 0.8021 <keras.src.callbacks.History at 0x7891bfa53eb0> ```