vggmodel = VGG16(weights='imagenet', include\_top=True)

IMAGE\_SIZE = [224, 224]

vgg = VGG16(input\_shape=IMAGE\_SIZE + [3], weights='imagenet', include\_top=False)

# don't train existing weights

for layer in vgg.layers:

  layer.trainable = False

x = Flatten()(vgg.output)

# x = Dense(1000, activation='relu')(x)

prediction = Dense(1, activation='sigmoid')(x)

# create a model object

model2 = Model(inputs=vgg.input, outputs=prediction)

model2.summary()

model2.compile(

    optimizer='adam',

    loss='binary\_crossentropy',

    metrics=['accuracy']

)

history = model2.fit(train\_images,

    validation\_data=val\_images,

    epochs=100,

    callbacks=[

        tf.keras.callbacks.EarlyStopping(

            monitor='val\_loss',

            patience=5,

            restore\_best\_weights=True

        ),

        tf.keras.callbacks.ReduceLROnPlateau(

            monitor='val\_loss',

            patience=3

        )

    ]

)

results = model2.evaluate(test\_images, verbose=0)

print("    Test Loss: {:.5f}".format(results[0]))

print("Test Accuracy: {:.2f}%".format(results[1] \* 100))

predictions = (model2.predict(test\_images) >= 0.5).astype(np.int)

cm = confusion\_matrix(test\_images.labels, predictions, labels=[0, 1])

clr = classification\_report(test\_images.labels, predictions, labels=[0, 1], target\_names=["covid", "normal"])

plt.figure(figsize=(6, 6))

sns.heatmap(cm, annot=True, fmt='g', vmin=0, cmap='Blues', cbar=False)

plt.xticks(ticks=[0.5, 1.5], labels=["covid", "normal"])

plt.yticks(ticks=[0.5, 1.5], labels=["covid", "normal"])

plt.xlabel("Predicted")

plt.ylabel("Actual")

plt.title("Confusion Matrix")

plt.show()

print("Classification Report:\n----------------------\n", clr)

model2.save(r'/content/drive/MyDrive/second model')

Found 316 validated image filenames belonging to 2 classes.

Found 78 validated image filenames belonging to 2 classes.

Found 169 validated image filenames belonging to 2 classes.

Model: "model\_1"

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Layer (type) Output Shape Param #

=================================================================

input\_6 (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\_9 (Flatten) (None, 25088) 0

dense\_16 (Dense) (None, 1) 25089

=================================================================

Total params: 14,739,777

Trainable params: 25,089

Non-trainable params: 14,714,688

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Epoch 1/100

10/10 [==============================] - 14s 1s/step - loss: 0.5518 - accuracy: 0.7880 - val\_loss: 0.4607 - val\_accuracy: 0.6795 - lr: 0.0010

Epoch 2/100

10/10 [==============================] - 12s 1s/step - loss: 0.3635 - accuracy: 0.8608 - val\_loss: 0.3167 - val\_accuracy: 0.9103 - lr: 0.0010

Epoch 3/100

10/10 [==============================] - 12s 1s/step - loss: 0.2908 - accuracy: 0.8892 - val\_loss: 0.3396 - val\_accuracy: 0.8205 - lr: 0.0010

Epoch 4/100

10/10 [==============================] - 12s 1s/step - loss: 0.2849 - accuracy: 0.8861 - val\_loss: 0.2812 - val\_accuracy: 0.8846 - lr: 0.0010

Epoch 5/100

10/10 [==============================] - 12s 1s/step - loss: 0.2362 - accuracy: 0.9082 - val\_loss: 0.2070 - val\_accuracy: 0.9103 - lr: 0.0010

Epoch 6/100

10/10 [==============================] - 12s 1s/step - loss: 0.1847 - accuracy: 0.9399 - val\_loss: 0.1660 - val\_accuracy: 0.9744 - lr: 0.0010

Epoch 7/100

10/10 [==============================] - 12s 1s/step - loss: 0.1531 - accuracy: 0.9430 - val\_loss: 0.1435 - val\_accuracy: 0.9744 - lr: 0.0010

Epoch 8/100

10/10 [==============================] - 12s 1s/step - loss: 0.1545 - accuracy: 0.9557 - val\_loss: 0.1668 - val\_accuracy: 0.9231 - lr: 0.0010

Epoch 9/100

10/10 [==============================] - 12s 1s/step - loss: 0.1402 - accuracy: 0.9652 - val\_loss: 0.1539 - val\_accuracy: 0.9487 - lr: 0.0010

Epoch 10/100

10/10 [==============================] - 12s 1s/step - loss: 0.1354 - accuracy: 0.9430 - val\_loss: 0.1359 - val\_accuracy: 0.9615 - lr: 0.0010

Epoch 11/100

10/10 [==============================] - 12s 1s/step - loss: 0.1394 - accuracy: 0.9620 - val\_loss: 0.1268 - val\_accuracy: 0.9744 - lr: 0.0010

Epoch 12/100

10/10 [==============================] - 12s 1s/step - loss: 0.1195 - accuracy: 0.9684 - val\_loss: 0.1383 - val\_accuracy: 0.9615 - lr: 0.0010

Epoch 13/100

10/10 [==============================] - 12s 1s/step - loss: 0.1106 - accuracy: 0.9810 - val\_loss: 0.1188 - val\_accuracy: 0.9487 - lr: 0.0010

Epoch 14/100

10/10 [==============================] - 12s 1s/step - loss: 0.1033 - accuracy: 0.9810 - val\_loss: 0.1103 - val\_accuracy: 0.9744 - lr: 0.0010

Epoch 15/100

10/10 [==============================] - 12s 1s/step - loss: 0.0889 - accuracy: 0.9810 - val\_loss: 0.1154 - val\_accuracy: 0.9744 - lr: 0.0010

Epoch 16/100

10/10 [==============================] - 12s 1s/step - loss: 0.1121 - accuracy: 0.9620 - val\_loss: 0.0893 - val\_accuracy: 0.9744 - lr: 0.0010

Epoch 17/100

10/10 [==============================] - 12s 1s/step - loss: 0.1037 - accuracy: 0.9652 - val\_loss: 0.1299 - val\_accuracy: 0.9487 - lr: 0.0010

Epoch 18/100

10/10 [==============================] - 12s 1s/step - loss: 0.0819 - accuracy: 0.9842 - val\_loss: 0.1057 - val\_accuracy: 0.9872 - lr: 0.0010

Epoch 19/100

10/10 [==============================] - 12s 1s/step - loss: 0.0978 - accuracy: 0.9715 - val\_loss: 0.1036 - val\_accuracy: 0.9744 - lr: 0.0010

Epoch 20/100

10/10 [==============================] - 12s 1s/step - loss: 0.0837 - accuracy: 0.9873 - val\_loss: 0.0792 - val\_accuracy: 1.0000 - lr: 1.0000e-04

Epoch 21/100

10/10 [==============================] - 12s 1s/step - loss: 0.0815 - accuracy: 0.9715 - val\_loss: 0.1160 - val\_accuracy: 0.9615 - lr: 1.0000e-04

Epoch 22/100

10/10 [==============================] - 12s 1s/step - loss: 0.0794 - accuracy: 0.9747 - val\_loss: 0.0952 - val\_accuracy: 0.9615 - lr: 1.0000e-04

Epoch 23/100

10/10 [==============================] - 12s 1s/step - loss: 0.0715 - accuracy: 0.9905 - val\_loss: 0.0919 - val\_accuracy: 0.9744 - lr: 1.0000e-04

Epoch 24/100

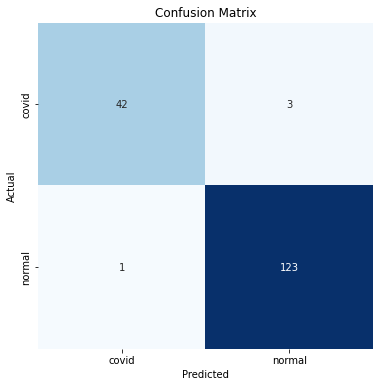
10/10 [==============================] - 12s 1s/step - loss: 0.0826 - accuracy: 0.9747 - val\_loss: 0.1122 - val\_accuracy: 0.9744 - lr: 1.0000e-05

Epoch 25/100

10/10 [==============================] - 12s 1s/step - loss: 0.0866 - accuracy: 0.9747 - val\_loss: 0.1144 - val\_accuracy: 0.9487 - lr: 1.0000e-05

Test Loss: 0.07729

Test Accuracy: 97.63%



Classification Report:

----------------------

precision recall f1-score support

covid 0.98 0.93 0.95 45

normal 0.98 0.99 0.98 124

accuracy 0.98 169

macro avg 0.98 0.96 0.97 169

weighted avg 0.98 0.98 0.98 169

INFO:tensorflow:Assets written to: /content/drive/MyDrive/second model/assets

summed for preds = [[0.415082 ]

[2.8843164 ]

[2.9513738 ]

[1.4154779 ]

[2.539606 ]

[2.8428812 ]

[2.5240428 ]

[1.8945261 ]

[2.1194215 ]

[2.6973195 ]

[2.9381132 ]

[0.2112303 ]

[2.9138641 ]

[1.5155607 ]

[2.0303407 ]

[2.913478 ]

[2.0480928 ]

[2.8028276 ]

[2.6457734 ]

[2.0290935 ]

[2.155924 ]

[1.6128122 ]

[2.406983 ]

[2.8933926 ]

[2.342649 ]

[2.9152966 ]

[2.872694 ]

[1.9997387 ]

[2.7064638 ]

[2.6503577 ]

[2.9294806 ]

[2.2614262 ]

[2.8808296 ]

[2.655729 ]

[0.6852109 ]

[2.8930979 ]

[2.812662 ]

[2.4055572 ]

[2.757104 ]

[2.830691 ]

[2.167179 ]

[2.5301237 ]

[1.8581059 ]

[0.3036924 ]

[1.2059311 ]

[2.8454602 ]

[1.3153062 ]

[0.7677963 ]

[0.48885724]

[0.3341523 ]

[2.5507188 ]

[0.3188585 ]

[2.9661555 ]

[0.5573504 ]

[2.9786627 ]

[2.7969518 ]

[1.7029707 ]

[0.5554652 ]

[0.64431405]

[2.719391 ]

[0.2330657 ]

[1.2717683 ]

[2.0143435 ]

[2.5744064 ]

[1.7256466 ]

[0.38797498]

[1.3420967 ]

[2.6248002 ]

[0.15780504]

[2.885247 ]

[0.3785288 ]

[2.7345333 ]

[2.8615355 ]

[0.15253423]

[0.6033735 ]

[2.3256092 ]

[2.503436 ]

[0.34942546]

[0.3869964 ]

[2.559227 ]

[1.7624104 ]

[2.5819376 ]

[2.497961 ]

[2.912373 ]

[1.6775146 ]

[2.94952 ]

[0.31759435]

[2.9310906 ]

[2.2811172 ]

[1.028692 ]

[2.675199 ]

[1.913799 ]

[2.8272567 ]

[0.5335439 ]

[0.58831596]

[2.9422524 ]

[2.6473994 ]

[1.5040662 ]

[2.3770275 ]

[2.7926178 ]

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[2.8536148 ]

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[2.4714246 ]

[2.6161594 ]

[2.9454849 ]

[0.9106717 ]

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[2.6902847 ]

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[2.74854 ]

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[2.5655644 ]

[2.7986305 ]

[1.3577235 ]

[2.2978158 ]

[1.9644053 ]

[2.1612153 ]

[0.5634685 ]

[1.687275 ]

[0.24297205]

[2.3233562 ]

[2.97586 ]

[0.1728063 ]

[2.1862683 ]

[1.6677737 ]

[2.9215689 ]

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[1.3687694 ]

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[0.2069647 ]

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[2.77483 ]

[2.756038 ]

[2.3276298 ]

[0.35371453]

[2.6233654 ]

[1.4652984 ]

[2.9051805 ]

[0.67418957]

[2.9453888 ]

[1.481536 ]

[2.832799 ]

[0.86272395]

[2.9388463 ]

[2.5538971 ]

[2.4963565 ]]

ensemble prediction = [[0]

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test\_images.labels = [0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1]

Accuracy Score for model1 = 0.834319526627219

Accuracy Score for model2 = 0.9763313609467456

Accuracy Score for model3 = 0.834319526627219

Accuracy Score for average ensemble = 0.9408284023668639

Accuracy Score for model1 = 0.834319526627219

Accuracy Score for model2 = 0.9763313609467456

Accuracy Score for model3 = 0.834319526627219

Accuracy Score for average ensemble = 0.9408284023668639

Accuracy Score for weighted average ensemble = [[0.16450745]

[0.95374706]

[0.98434144]

[0.37511918]

[0.82394196]

[0.93762479]

[0.81082716]

[0.56018127]

[0.64826605]

[0.88758422]

[0.97634492]

[0.0841585 ]

[0.96599542]

[0.43293849]

[0.63701702]

[0.96568422]

[0.62076551]

[0.92263353]

[0.87282629]

[0.61234879]

[0.67496088]

[0.44560689]

[0.76540654]

[0.95745521]

[0.73926044]

[0.96799163]

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[0.79720478]

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[0.97335123]

[0.70458877]

[0.95378863]

[0.86245145]

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[0.96369507]

[0.92548636]

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[0.9040192 ]

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[0.12085778]

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[0.12606294]

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[0.97983255]

[0.1262296 ]

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[0.32666174]

[0.87241573]

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[0.94306991]

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[0.17049811]

[0.89091815]

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[0.91118873]

[0.90246397]

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[0.1392144 ]

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[0.57840297]

[0.97377048]

[0.24257013]

[0.97863383]

[0.4056425 ]

[0.95246865]

[0.34495183]

[0.97562915]

[0.82195815]

[0.7993803 ]]

Accuracy Score for weighted average ensemble = [[0]

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Accuracy Score for weighted average ensemble = 0.893491124260355

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WARNING:tensorflow:A checkpoint was restored (e.g. tf.train.Checkpoint.restore or tf.keras.Model.load\_weights) but not all checkpointed values were used. See above for specific issues. Use expect\_partial() on the load status object, e.g. tf.train.Checkpoint.restore(...).expect\_partial(), to silence these warnings, or use assert\_consumed() to make the check explicit. See <https://www.tensorflow.org/guide/checkpoint#loading_mechanics> for details.

Max accuracy of 0.4 obained with w1= 0.4 w2= 0.1 and w3= 97.0414201183432