In [1]:
```
from keras.layers import Input, Lambda, Dense, Flatten
from keras.models import Model
from keras.applications.vgg16 import VGG16
from keras.preprocessing import image
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
import numpy as np
from glob import glob
import matplotlib.pyplot as plt

import warnings
warnings.filterwarnings('ignore')
```

```
Using TensorFlow backend.
C:\Users\shash\anaconda3\lib\site-packages\tensorflow\python\framework\dtypes.py:516: FutureWarning: Passing (type,
1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,))
/ '(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorflow\python\framework\dtypes.py:517: FutureWarning: Passing (type,
1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,))
/ '(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorflow\python\framework\dtypes.py:518: FutureWarning: Passing (type,
1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,))
/ '(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorflow\python\framework\dtypes.py:519: FutureWarning: Passing (type,
1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,))
/ '(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorflow\python\framework\dtypes.py:520: FutureWarning: Passing (type,
1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,))
/ '(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorflow\python\framework\dtypes.py:525: FutureWarning: Passing (type,
1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,))
/ '(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorboard\compat\tensorflow_stub\dtypes.py:541: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (typ
e, (1,)) / '(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorboard\compat\tensorflow_stub\dtypes.py:542: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (typ
e, (1,)) / '(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorboard\compat\tensorflow_stub\dtypes.py:543: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (typ
e, (1,)) / '(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorboard\compat\tensorflow_stub\dtypes.py:544: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (typ
e, (1,)) / '(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
```

```
C:\Users\shash\anaconda3\lib\site-packages\tensorboard\compat\tensorflow_stub\dtypes.py:545: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (typ
e, (1,)) / '(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
C:\Users\shash\anaconda3\lib\site-packages\tensorboard\compat\tensorflow_stub\dtypes.py:550: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (typ
e, (1,)) / '(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
```

In [2]:
```
from keras.models import load_model

IMAGE_SIZE = [224, 224]

train_path = r'S:\VIT AP\SummerInternship1\COVID 19\train'
valid_path = r'S:\VIT AP\SummerInternship1\COVID 19\test'
```

In [3]:
```
# add preprocessing layer
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
```

```
WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\keras\backend\tensorflow_backend.py:74: The name t
f.get_default_graph is deprecated. Please use tf.compat.v1.get_default_graph instead.

WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\keras\backend\tensorflow_backend.py:517: The name
tf.placeholder is deprecated. Please use tf.compat.v1.placeholder instead.

WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\keras\backend\tensorflow_backend.py:4138: The name
tf.random_uniform is deprecated. Please use tf.random.uniform instead.

WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\keras\backend\tensorflow_backend.py:3976: The name
tf.nn.max_pool is deprecated. Please use tf.nn.max_pool2d instead.

WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\keras\backend\tensorflow_backend.py:174: The name
tf.get_default_session is deprecated. Please use tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\keras\backend\tensorflow_backend.py:181: The name
tf.ConfigProto is deprecated. Please use tf.compat.v1.ConfigProto instead.
```

In [4]:
```
# layers
x = Flatten()(vgg.output)
# x = Dense(1000, activation='relu')(x)
prediction = Dense(7, activation='softmax')(x)
```

In [5]:
```
# create a model object
model = Model(inputs=vgg.input, outputs=prediction)
```

In [6]:
```
# view the structure of the model
model.summary()
```

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_1 (Flatten)          (None, 25088)             0
_________________________________________________________________
dense_1 (Dense)              (None, 7)                 175623
=================================================================
Total params: 14,890,311
Trainable params: 175,623
Non-trainable params: 14,714,688
_________________________________________________________________
```

In [7]:
```
# telling the model what cost and optimization method to use
model.compile(
  loss='categorical_crossentropy',
  optimizer='adam',
  metrics=['accuracy']
)
```

```
WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\keras\optimizers.py:790: The name tf.train.Optimiz
er is deprecated. Please use tf.compat.v1.train.Optimizer instead.
```

In [8]:
```
#resizing the images
train_datagen = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

test_datagen = ImageDataGenerator(rescale = 1./255)
```

In [9]:
```
training_set = train_datagen.flow_from_directory(r'S:\VIT AP\SummerInternship1\COVID 19\train',
                                                 target_size = (224, 224),
                                                 batch_size = 1,
                                                 class_mode = 'categorical')
```

```
Found 289 images belonging to 7 classes.
```

In [10]:
```
test_set = test_datagen.flow_from_directory(r'S:\VIT AP\SummerInternship1\COVID 19\test',
                                            target_size = (224, 224),
                                            batch_size = 1,
                                            class_mode = 'categorical')
```

```
Found 76 images belonging to 7 classes.
```

In [11]:
```
# fit the model
r = model.fit_generator(
  training_set,
  validation_data=test_set,
  epochs=50,
  steps_per_epoch=len(training_set),
  validation_steps=len(test_set)
)
```

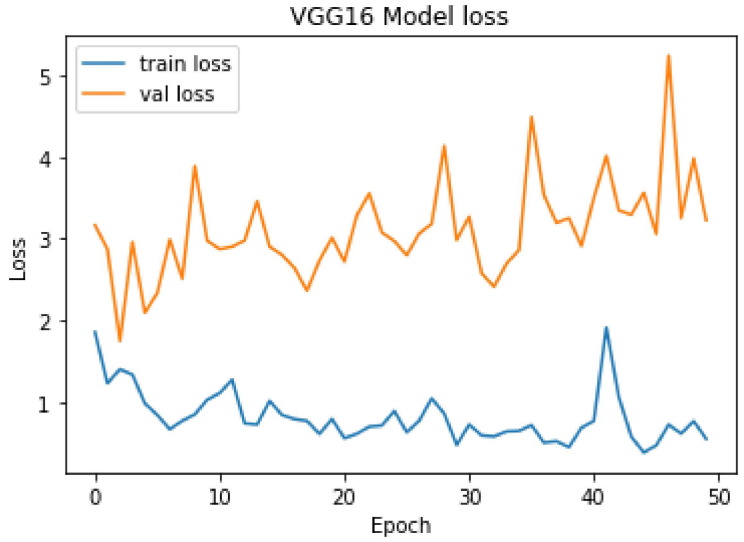
```
WARNING:tensorflow:From C:\Users\shash\anaconda3\lib\site-packages\tensorflow\python\ops\math_grad.py:1250: add_dispa
tch_support.<locals>.wrapper (from tensorflow.python.ops.array_ops) is deprecated and will be removed in a future ver
sion.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
Epoch 1/50
289/289 [==============================] - 96s 333ms/step - loss: 1.8564 - acc: 0.6228 - val_loss: 3.1675 - val_acc:
0.3684
Epoch 2/50
289/289 [==============================] - 90s 313ms/step - loss: 1.2303 - acc: 0.7647 - val_loss: 2.8729 - val_acc:
0.5658
Epoch 3/50
289/289 [==============================] - 98s 341ms/step - loss: 1.4017 - acc: 0.7855 - val_loss: 1.7490 - val_acc:
0.7500
Epoch 4/50
289/289 [==============================] - 97s 335ms/step - loss: 1.3368 - acc: 0.7889 - val_loss: 2.9603 - val_acc:
0.6711
Epoch 5/50
289/289 [==============================] - 94s 325ms/step - loss: 0.9838 - acc: 0.8651 - val_loss: 2.0940 - val_acc:
0.7237
Epoch 6/50
289/289 [==============================] - 96s 333ms/step - loss: 0.8406 - acc: 0.8824 - val_loss: 2.3382 - val_acc:
0.6316
Epoch 7/50
289/289 [==============================] - 96s 332ms/step - loss: 0.6671 - acc: 0.8962 - val_loss: 2.9898 - val_acc:
0.7500
Epoch 8/50
289/289 [==============================] - 96s 333ms/step - loss: 0.7701 - acc: 0.8789 - val_loss: 2.5132 - val_acc:
0.7632
Epoch 9/50
289/289 [==============================] - 96s 333ms/step - loss: 0.8492 - acc: 0.8616 - val_loss: 3.8906 - val_acc:
0.5132
Epoch 10/50
289/289 [==============================] - 96s 334ms/step - loss: 1.0281 - acc: 0.8754 - val_loss: 2.9759 - val_acc:
0.7105
Epoch 11/50
289/289 [==============================] - 69s 238ms/step - loss: 1.1109 - acc: 0.8858 - val_loss: 2.8737 - val_acc:
0.7763
Epoch 12/50
289/289 [==============================] - 64s 222ms/step - loss: 1.2736 - acc: 0.8581 - val_loss: 2.9031 - val_acc:
0.6316
```

```
Epoch 13/50
289/289 [==============================] - 70s 241ms/step - loss: 0.7397 - acc: 0.9066 - val_loss: 2.9795 - val_acc:
0.7500
Epoch 14/50
289/289 [==============================] - 80s 277ms/step - loss: 0.7245 - acc: 0.9170 - val_loss: 3.4605 - val_acc:
0.6711
Epoch 15/50
289/289 [==============================] - 78s 268ms/step - loss: 1.0138 - acc: 0.8754 - val_loss: 2.9041 - val_acc:
0.6316
Epoch 16/50
289/289 [==============================] - 78s 269ms/step - loss: 0.8413 - acc: 0.8962 - val_loss: 2.8018 - val_acc:
0.7500
Epoch 17/50
289/289 [==============================] - 77s 267ms/step - loss: 0.7919 - acc: 0.9100 - val_loss: 2.6426 - val_acc:
0.7368
Epoch 18/50
289/289 [==============================] - 77s 265ms/step - loss: 0.7688 - acc: 0.9066 - val_loss: 2.3645 - val_acc:
0.7368
Epoch 19/50
289/289 [==============================] - 80s 277ms/step - loss: 0.6095 - acc: 0.9412 - val_loss: 2.7346 - val_acc:
0.8026
Epoch 20/50
289/289 [==============================] - 101s 350ms/step - loss: 0.7924 - acc: 0.9135 - val_loss: 3.0118 - val_acc:
0.6974
Epoch 21/50
289/289 [==============================] - 94s 324ms/step - loss: 0.5572 - acc: 0.9446 - val_loss: 2.7197 - val_acc:
0.7895
Epoch 22/50
289/289 [==============================] - 108s 375ms/step - loss: 0.6116 - acc: 0.9170 - val_loss: 3.2880 - val_acc:
0.7105
Epoch 23/50
289/289 [==============================] - 109s 377ms/step - loss: 0.6989 - acc: 0.9066 - val_loss: 3.5570 - val_acc:
0.6579
Epoch 24/50
289/289 [==============================] - 110s 380ms/step - loss: 0.7132 - acc: 0.9308 - val_loss: 3.0776 - val_acc:
0.7763
Epoch 25/50
289/289 [==============================] - 109s 375ms/step - loss: 0.8901 - acc: 0.9100 - val_loss: 2.9727 - val_acc:
0.6447
Epoch 26/50
289/289 [==============================] - 110s 381ms/step - loss: 0.6293 - acc: 0.9377 - val_loss: 2.7973 - val_acc:
0.7500
```

```
Epoch 27/50
289/289 [==============================] - 108s 375ms/step - loss: 0.7724 - acc: 0.9031 - val_loss: 3.0656 - val_acc:
0.7632
Epoch 28/50
289/289 [==============================] - 109s 376ms/step - loss: 1.0454 - acc: 0.9031 - val_loss: 3.1832 - val_acc:
0.6579
Epoch 29/50
289/289 [==============================] - 107s 371ms/step - loss: 0.8582 - acc: 0.9170 - val_loss: 4.1384 - val_acc:
0.6447
Epoch 30/50
289/289 [==============================] - 108s 375ms/step - loss: 0.4757 - acc: 0.9585 - val_loss: 2.9854 - val_acc:
0.6974
Epoch 31/50
289/289 [==============================] - 110s 380ms/step - loss: 0.7242 - acc: 0.8997 - val_loss: 3.2709 - val_acc:
0.7500
Epoch 32/50
289/289 [==============================] - 109s 376ms/step - loss: 0.5919 - acc: 0.9343 - val_loss: 2.5780 - val_acc:
0.7632
Epoch 33/50
289/289 [==============================] - 110s 382ms/step - loss: 0.5792 - acc: 0.9516 - val_loss: 2.4126 - val_acc:
0.7895
Epoch 34/50
289/289 [==============================] - 98s 339ms/step - loss: 0.6405 - acc: 0.9239 - val_loss: 2.6975 - val_acc:
0.7368
Epoch 35/50
289/289 [==============================] - 75s 259ms/step - loss: 0.6464 - acc: 0.9170 - val_loss: 2.8615 - val_acc:
0.7632
Epoch 36/50
289/289 [==============================] - 74s 258ms/step - loss: 0.7171 - acc: 0.9273 - val_loss: 4.4935 - val_acc:
0.6184
Epoch 37/50
289/289 [==============================] - 75s 258ms/step - loss: 0.5024 - acc: 0.9550 - val_loss: 3.5352 - val_acc:
0.7105
Epoch 38/50
289/289 [==============================] - 75s 258ms/step - loss: 0.5205 - acc: 0.9446 - val_loss: 3.1959 - val_acc:
0.7500
Epoch 39/50
289/289 [==============================] - 78s 270ms/step - loss: 0.4472 - acc: 0.9516 - val_loss: 3.2531 - val_acc:
0.7368
Epoch 40/50
289/289 [==============================] - 87s 300ms/step - loss: 0.6845 - acc: 0.9412 - val_loss: 2.9135 - val_acc:
0.6974
```

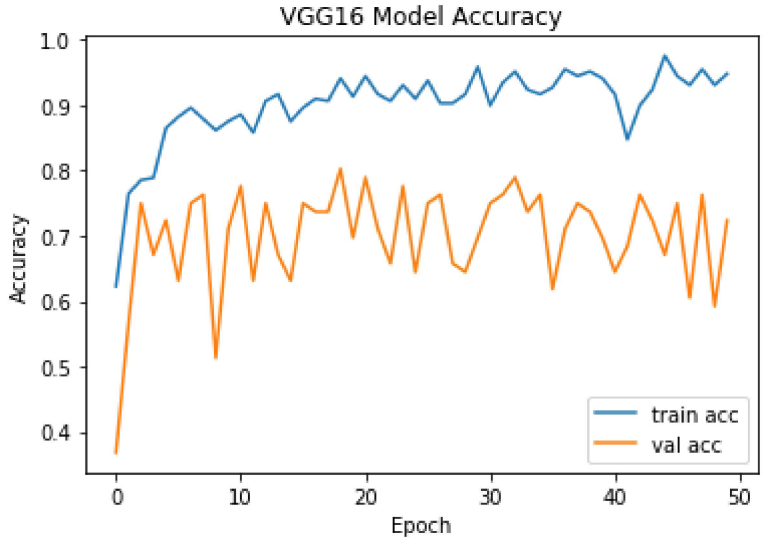
```
Epoch 41/50
289/289 [==============================] - 79s 272ms/step - loss: 0.7696 - acc: 0.9170 - val_loss: 3.5019 - val_acc:
0.6447
Epoch 42/50
289/289 [==============================] - 79s 273ms/step - loss: 1.9119 - acc: 0.8478 - val_loss: 4.0135 - val_acc:
0.6842
Epoch 43/50
289/289 [==============================] - 91s 315ms/step - loss: 1.0631 - acc: 0.8997 - val_loss: 3.3480 - val_acc:
0.7632
Epoch 44/50
289/289 [==============================] - 82s 283ms/step - loss: 0.5751 - acc: 0.9239 - val_loss: 3.2960 - val_acc:
0.7237
Epoch 45/50
289/289 [==============================] - 75s 261ms/step - loss: 0.3826 - acc: 0.9758 - val_loss: 3.5648 - val_acc:
0.6711
Epoch 46/50
289/289 [==============================] - 75s 260ms/step - loss: 0.4693 - acc: 0.9446 - val_loss: 3.0583 - val_acc:
0.7500
Epoch 47/50
289/289 [==============================] - 76s 263ms/step - loss: 0.7236 - acc: 0.9308 - val_loss: 5.2420 - val_acc:
0.6053
Epoch 48/50
289/289 [==============================] - 79s 272ms/step - loss: 0.6130 - acc: 0.9550 - val_loss: 3.2538 - val_acc:
0.7632
Epoch 49/50
289/289 [==============================] - 79s 275ms/step - loss: 0.7668 - acc: 0.9308 - val_loss: 3.9848 - val_acc:
0.5921
Epoch 50/50
289/289 [==============================] - 75s 259ms/step - loss: 0.5498 - acc: 0.9481 - val_loss: 3.2266 - val_acc:
0.7237
```

In [12]:
```
# loss
plt.plot(r.history['loss'], label='train loss')
plt.plot(r.history['val_loss'], label='val loss')
plt.legend()
plt.title('VGG16 Model loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.show()
plt.savefig('LossVal_loss')
```




```
<Figure size 432x288 with 0 Axes>
```

In [13]:
```
# accuracies
plt.plot(r.history['acc'], label='train acc')
plt.plot(r.history['val_acc'], label='val acc')
plt.legend()
plt.title('VGG16 Model Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.show()
plt.savefig('AccVal_acc')
```




```
<Figure size 432x288 with 0 Axes>
```

In [14]:
```
import tensorflow as tf
from keras.models import load_model
```

In [15]:
```
model.save('covidchest_vgg.h5')
```

In [19]:
```
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score
```

In [22]:
```
predict = model.predict_generator(test_set, steps=len(test_set), verbose=1)
```

```
76/76 [==============================] - 11s 140ms/step
```

In [21]:
```
test_label = test_set.classes
```

In [24]:
```
accuracy_score(test_label,predict.argmax(axis=1))
```

Out[24]:
```
0.2631578947368421
```

Done!