Problem Statement

Dataset contains 1251 CT scans that are positive for SARS-CoV-2 infection (COVID-19) and 1229 CT scans for patients non-infected by SARS-CoV-2, 2480 CT scans in total. These data have been collected from real patients in hospitals from Sao Paulo, Brazil. The aim is to identify if a person is infected by SARS-CoV-2 through the analysis of his/her CT scans.

```
[ ]  #Importing Libraries
     import numpy as np
     import pandas as pd
     import matplotlib.pyplot as plt
     import seaborn as sns
     import pathlib
     import os
     import cv2

     from tqdm import tqdm
     from keras.utils import to_categorical

     from sklearn.model_selection import train_test_split
```

```
import tensorflow as tf

from keras.models import Model,Sequential, load_model
from keras.layers import Dense, Dropout, Flatten, Conv2D, MaxPool2D, BatchNormalization, AveragePooling2D, GlobalAveragePooling2D
from keras.optimizers import Adam
from keras.optimizers.legacy import Adamax
from keras.preprocessing.image import ImageDataGenerator
from keras.callbacks import ModelCheckpoint, ReduceLROnPlateau
from keras.applications.resnet50 import ResNet50
from keras.preprocessing import image
from keras.applications.resnet50 import preprocess_input, decode_predictions
from skimage import io

from keras import Input
from sklearn.metrics import confusion_matrix,accuracy_score,classification_report
```

ta Mining

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
data_cov=pathlib.Path('/content/drive/MyDrive/Capstone_project/COVID')
data_non_cov=pathlib.Path('/content/drive/MyDrive/Capstone_project/non-COVID')


print("No. of images which are showing covid: ",len(list(data_cov.glob('*png')))) #.glob() is used to find files, here it is giving the number of .png files
print("No. of images which are normal: ",len(list(data_non_cov.glob('*png'))))
```

```
No. of images which are showing covid:  1251
No. of images which are normal:  1229
```

```
#no. of covid and non covid images are approximately same


disease_types=['COVID', 'non-COVID']
data_dir = '/content/drive/MyDrive/Capstone_project'
train_dir = os.path.join(data_dir)
#it is used to join more than one path together


train_data = []
for defects_id, sp in enumerate(disease_types):
    for file in os.listdir(os.path.join(train_dir, sp)):
        train_data.append(['{}/{}'.format(sp, file), defects_id, sp])

train = pd.DataFrame(train_data, columns=['File', 'DiseaseID','Disease Type']) #created a pandas dataframe, with new columns as disease id and disease type
train.head()
```

	File	DiseaseID	Disease Type
0	COVID/Covid (215).png	0	COVID
1	COVID/Covid (124).png	0	COVID
2	COVID/Covid (26).png	0	COVID
3	COVID/Covid (187).png	0	COVID
4	COVID/Covid (203).png	0	COVID

```
train
```

	File	DiseaseID	Disease Type
0	COVID/Covid (215).png	0	COVID
1	COVID/Covid (124).png	0	COVID
2	COVID/Covid (26).png	0	COVID
3	COVID/Covid (187).png	0	COVID
4	COVID/Covid (203).png	0	COVID
...	...	...	...
2476	non-COVID/Non-Covid (1132).png	1	non-COVID

2476	non-COVID/Non-Covid (1132).png	1	non-COVID
2477	non-COVID/Non-Covid (1061).png	1	non-COVID
2478	non-COVID/Non-Covid (1174).png	1	non-COVID
2479	non-COVID/Non-Covid (1022).png	1	non-COVID
2480	non-COVID/Non-Covid (1028).png	1	non-COVID

2481 rows × 3 columns

```
#displaying some of images of covid training data set
def plot_defects(defect_types, rows, cols):
    fig, ax = plt.subplots(rows, cols, figsize=(12, 12))
    defect_files = train['File'][train['Disease Type'] == defect_types].values
    n = 0
    for i in range(rows):
        for j in range(cols):
            image_path = os.path.join(data_dir, defect_files[n])
            ax[i, j].set_xticks([])
            ax[i, j].set_yticks([])
            ax[i, j].imshow(cv2.imread(image_path))
            n += 1
plot_defects('COVID', 3, 3)
```



```
displaying some of images of non-covid training data set
ef plot_defects(defect_types, rows, cols):
    fig, ax = plt.subplots(rows, cols, figsize=(12, 12))
    defect_files = train['File'][train['Disease Type'] == defect_types].values
    n = 0
    for i in range(rows):
        for j in range(cols):
            image_path = os.path.join(data_dir, defect_files[n])
            ax[i, j].set_xticks([])
            ax[i, j].set_yticks([])
            ax[i, j].imshow(cv2.imread(image_path))
            n += 1
```

```
#Data Augmentation
model = build_resnet50()
annealer = ReduceLROnPlateau(monitor='val_accuracy', factor=0.70, patience=5, verbose=1, min_learning_rate=1e-4)
checkpoint = ModelCheckpoint('model.h5', verbose=1, save_best_only=True)
datagen = ImageDataGenerator(rotation_range=360, #Degree range for rotations
                         width_shift_range=0.2, #horizontal shifts
                         height_shift_range=0.2, #vertical shifts
                         zoom_range=0.2, #Range for zoom
                         horizontal_flip=True, #flip inputs horizontally
                         vertical_flip=True) #flip inputs vertically

datagen.fit(X_train)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/resnet/resnet50_weights_tf_dim_ordering_tf_kernels_notop.h5
94765736/94765736 [==============================] - 1s 0us/step
Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_2 (InputLayer)         [(None, 64, 64, 3)]       0

conv2d (Conv2D)              (None, 64, 64, 3)         84

resnet50 (Functional)        (None, None, None, 2048   23587712
                             )

global_average_pooling2d (   (None, 2048)              0
```

```python
#Early Stopping
early_stopping=tf.keras.callbacks.EarlyStopping(
    monitor="val_loss",
    min_delta=0.0001,
    patience=20,
    verbose=1,
    mode="auto",
    baseline=None,
    restore_best_weights=False,
)


history = model.fit(datagen.flow(X_train, Y_train, batch_size=Batch_Size),
                steps_per_epoch=X_train.shape[0] // Batch_Size,
                epochs=Epochs,
                verbose=1,
                callbacks=[annealer, checkpoint, early_stopping],
                validation_data=(X_val, Y_val))
```

```
Epoch 1/500
30/30 [==============================] - ETA: 0s - loss: 1.1628 - accuracy: 0.5883
Epoch 1: val_loss improved from inf to 1.44837, saving model to model.h5
/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.py:3079: UserWarning: You are saving your model as an HDF5 file via `model.save()`. This file f
  saving_api.save_model(
30/30 [==============================] - 28s 335ms/step - loss: 1.1628 - accuracy: 0.5883 - val_loss: 1.4484 - val_accuracy: 0.5191 - lr: 0.0020
Epoch 2/500
```

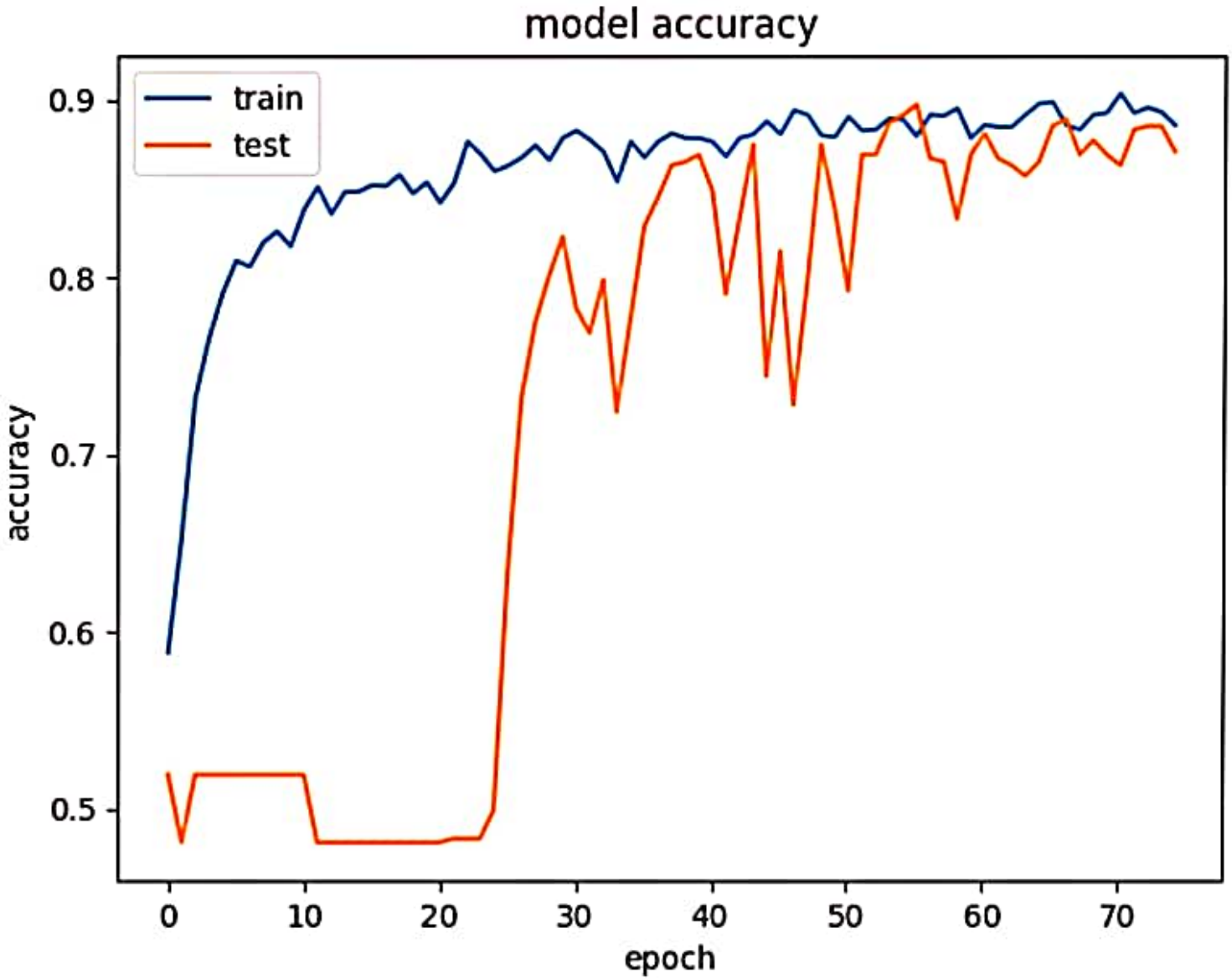
Splitting and Creating Model

```
[ ]  Batch_Size=65
     #splitting the data for training and validation
     X_train,X_val,Y_train,Y_val=train_test_split(X_Train,Y_train,test_size=0.2,random_state=42)
```

```
[ ]  X_train.shape

     (1984, 64, 64, 3)
```

```
[ ]  X_val.shape

     (497, 64, 64, 3)
```

```
[ ]  Y_train.shape

     (1984, 2)
```


model accuracy
train
test
0.9
0.8
0.7
0.6
0.5
accuracy
0
10
20
30
40
50
60
70
epoch

Model Prediction

```
Y_pred = model.predict(X_val)

Y_pred = np.argmax(Y_pred, axis=1)
Y_true = np.argmax(Y_val, axis=1)
```

```
16/16 [==============================] - 1s 19ms/step
```

```
from skimage import io
from tensorflow.keras.preprocessing import image
img = image.load_img('/content/drive/MyDrive/Capstone_project/COVID/Covid (150).png', grayscale=False, target_size=(64, 64))
show_img=image.load_img('/content/drive/MyDrive/Capstone_project/COVID/Covid (150).png', grayscale=False, target_size=(200, 200))
disease_class=['Covid-19','Non Covid-19']
x = image.img_to_array(img)
x = np.expand_dims(x, axis = 0)
x /= 255

custom = model.predict(x)
print(custom[0])

plt.imshow(show_img)
```

Multiple Performance Metrics

```
[ ] confusion_matrix(Y_true, Y_pred)
```

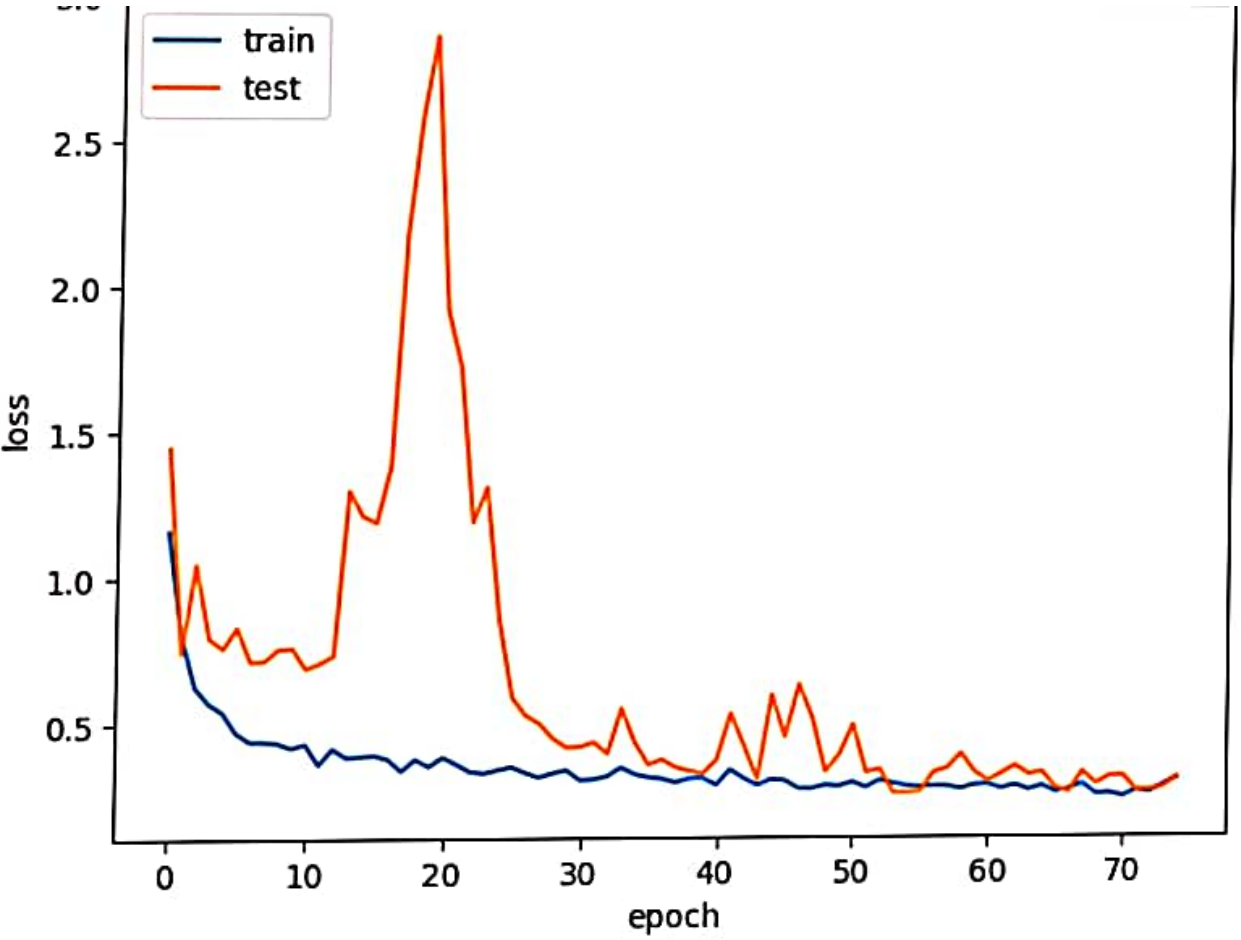
```
array([[217,  22],
       [ 42, 216]])
```

```
[ ] accuracy_score(Y_true, Y_pred)
```

```
0.8712273641851107
```

```
[ ] plt.plot(history.history['accuracy'])
    plt.plot(history.history['val_accuracy'])
    plt.title('model accuracy')
    plt.ylabel('accuracy')
    plt.xlabel('epoch')
    plt.legend(['train', 'test'], loc='upper left')
```

```
<matplotlib.legend.Legend at 0x7c2fdad1de10>
```

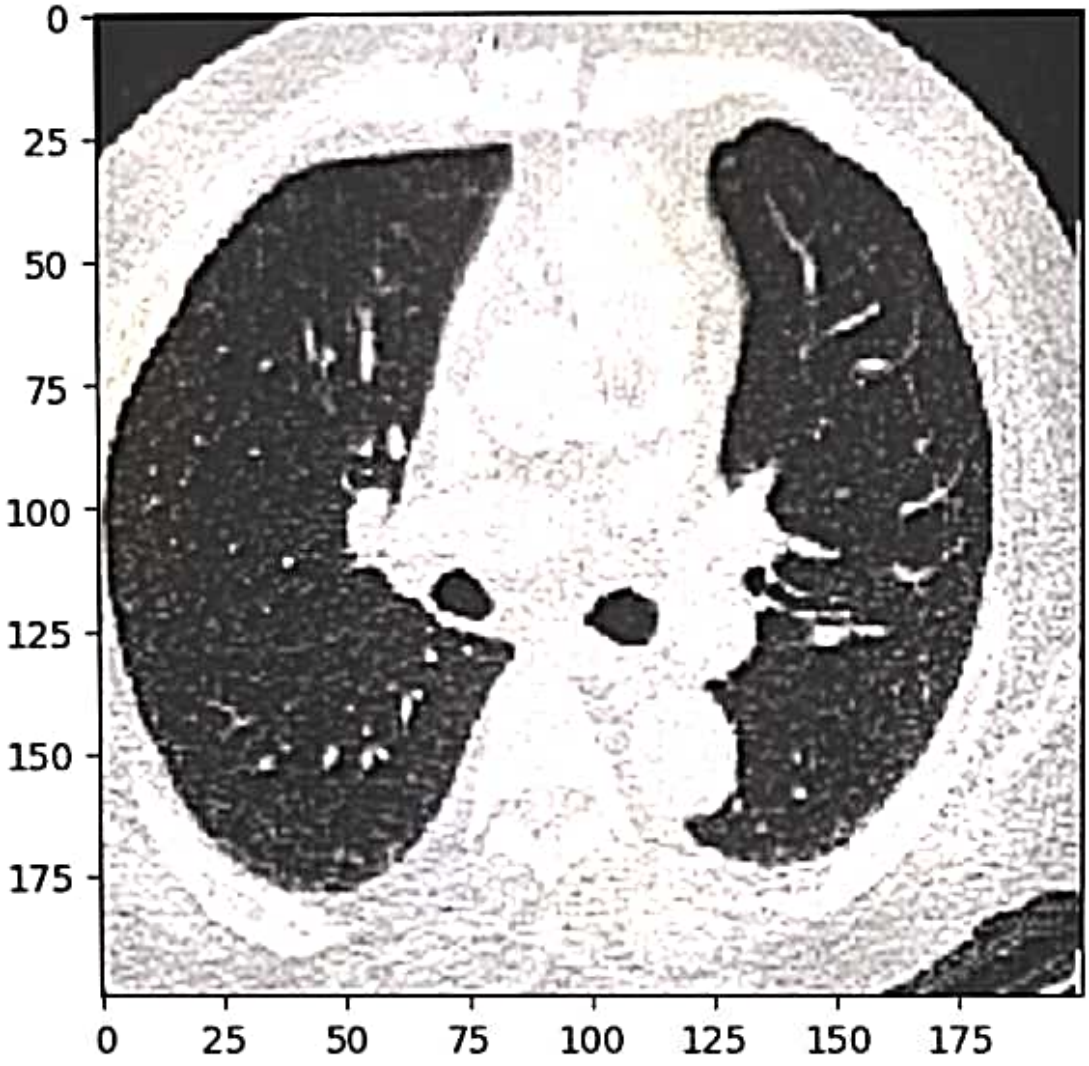



```
int(classification_report(Y_true, Y_pred, target_names=disease_class))
```

```
print(classification_report(Y_true, Y_pred, target_names=disease_class))
```

```
              precision    recall  f1-score   support

    Covid-19       0.84      0.91      0.87       239
Non Covid-19       0.91      0.84      0.87       258

    accuracy                           0.87       497
   macro avg       0.87      0.87      0.87       497
weighted avg       0.87      0.87      0.87       497
```

```
1/1 [==============================] - 0s 393ms/step
[9.9996769e-01 3.2299224e-05]
<matplotlib.image.AxesImage at 0x7c2fdae92950>
```



```
#Creating the model
def build_resnet50():
    resnet50 = ResNet50(weights='imagenet', include_top=False)

    input = Input(shape=(size,size,3))
    x = Conv2D(3, (3, 3), padding='same')(input)

    x = resnet50(x)

    x = GlobalAveragePooling2D()(x)
    x = BatchNormalization()(x)
    x = Dropout(0.5)(x)
    x = Dense(256, activation='relu')(x)
    x = BatchNormalization()(x)
    x = Dropout(0.5)(x)
    output = Dense(2,activation = 'softmax', name='root')(x)


    # model
    model = Model(input,output)
```

```
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
```

```
<matplotlib.legend.Legend at 0x7c2fdad6bf70>
```