In [ ]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn
```

In [ ]:

```
from matplotlib.image import imread
import os
import random
```

In [ ]:

```
from google.colab import drive
drive.mount('/content/gdrive',force_remount=True)
```

```
Mounted at /content/gdrive
```

In [ ]:

```
data=pd.read_csv('/content/gdrive/MyDrive/1.3 Healthcare AI Datasets.zip (Unzipped Files)
/Healthcare AI Datasets/Brain_MRI/data_mask.csv')
```

In [ ]:

```
data.head()
```

Out[ ]:

	patient_id	image_path	mask_path
0	TCGA_CS_5395_19981004	TCGA_CS_5395_19981004/TCGA_CS_5395_19981004_1.tif	TCGA_CS_5395_19981004/TCGA_CS_5395_
1	TCGA_CS_5395_19981004	TCGA_CS_4944_20010208/TCGA_CS_4944_20010208_1.tif	TCGA_CS_4944_20010208/TCGA_CS_4944_
2	TCGA_CS_5395_19981004	TCGA_CS_4941_19960909/TCGA_CS_4941_19960909_1.tif	TCGA_CS_4941_19960909/TCGA_CS_4941_
3	TCGA_CS_5395_19981004	TCGA_CS_4943_20000902/TCGA_CS_4943_20000902_1.tif	TCGA_CS_4943_20000902/TCGA_CS_4943_
4	TCGA_CS_5395_19981004	TCGA_CS_5396_20010302/TCGA_CS_5396_20010302_1.tif	TCGA_CS_5396_20010302/TCGA_CS_5396_

In [ ]:

```
data.columns
```

Out[ ]:

```
Index(['patient_id', 'image_path', 'mask_path', 'mask'], dtype='object')
```

In [ ]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3929 entries, 0 to 3928
Data columns (total 4 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   patient_id  3929 non-null   object
 1   image_path  3929 non-null   object
 2   mask_path   3929 non-null   object
 3   mask        3929 non-null   int64 
dtypes: int64(1), object(3)
memory usage: 122.9+ KB
```

In [ ]:

```
data['mask'].value_counts()
```

Out[ ]:

```
0    2556
1    1373
Name: mask, dtype: int64
```

In [ ]:

```
plt.imshow(imread('https://meet.google.com/zrh-tvcb-ewq'))
```

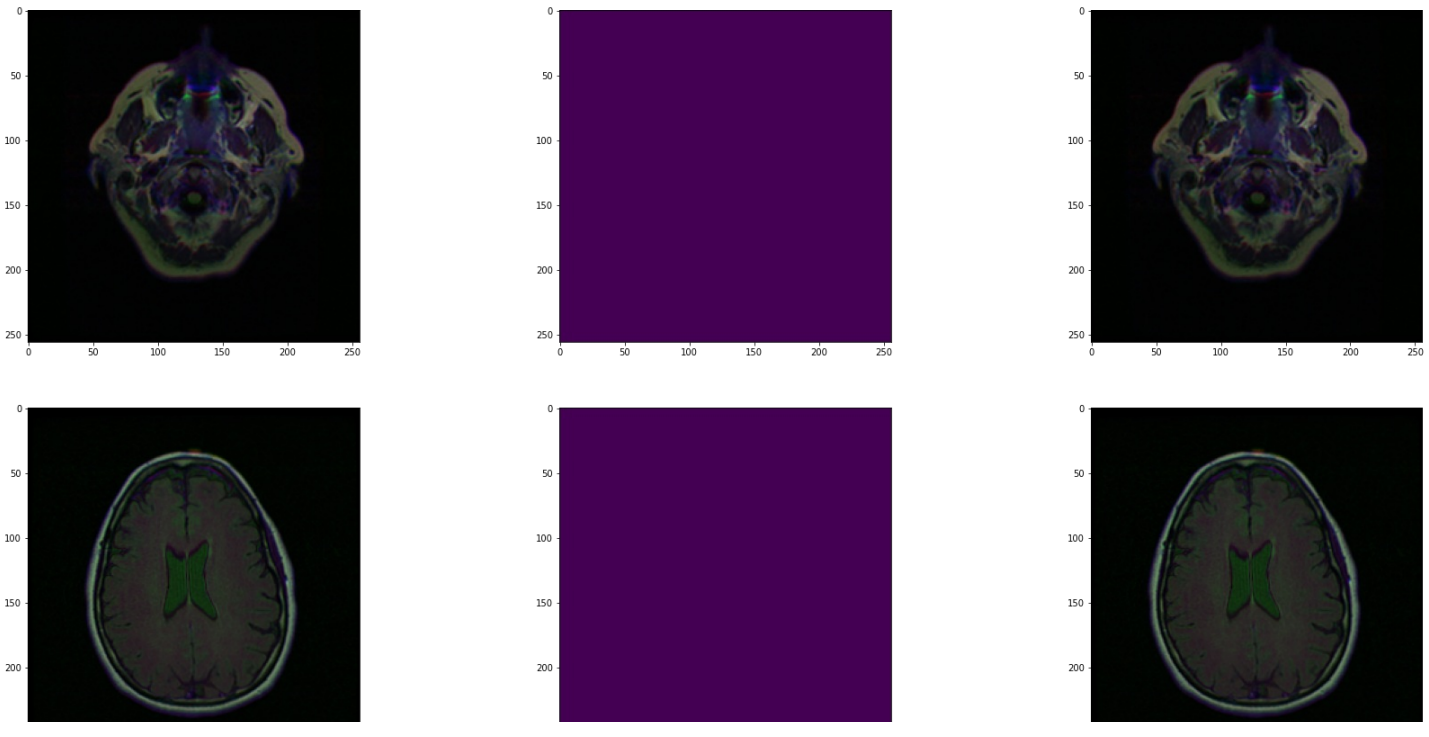
```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-12-f8426a7bc03b> in <module>()
----> 1 plt.imshow(imread('https://meet.google.com/zrh-tvcb-ewq'))

/usr/local/lib/python3.6/dist-packages/matplotlib/image.py in imread(fname, format)
   1471             from urllib import request
   1472             fd = BytesIO(request.urlopen(fname).read())
-> 1473             return _png.read_png(fd)
   1474     with cbook.open_file_cm(fname, "rb") as file:
   1475         return _png.read_png(file)

ValueError: invalid PNG header
```

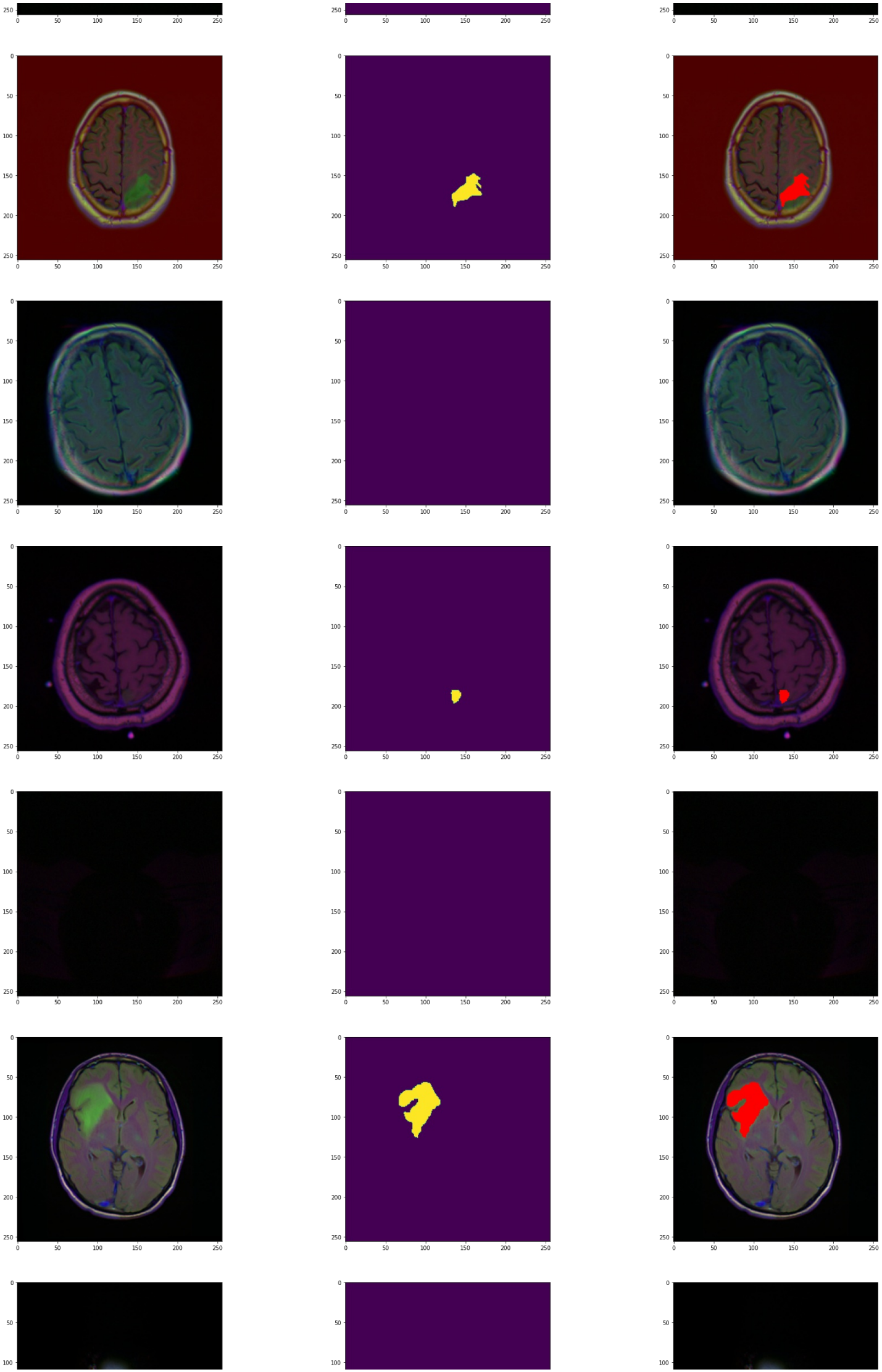
In [ ]:

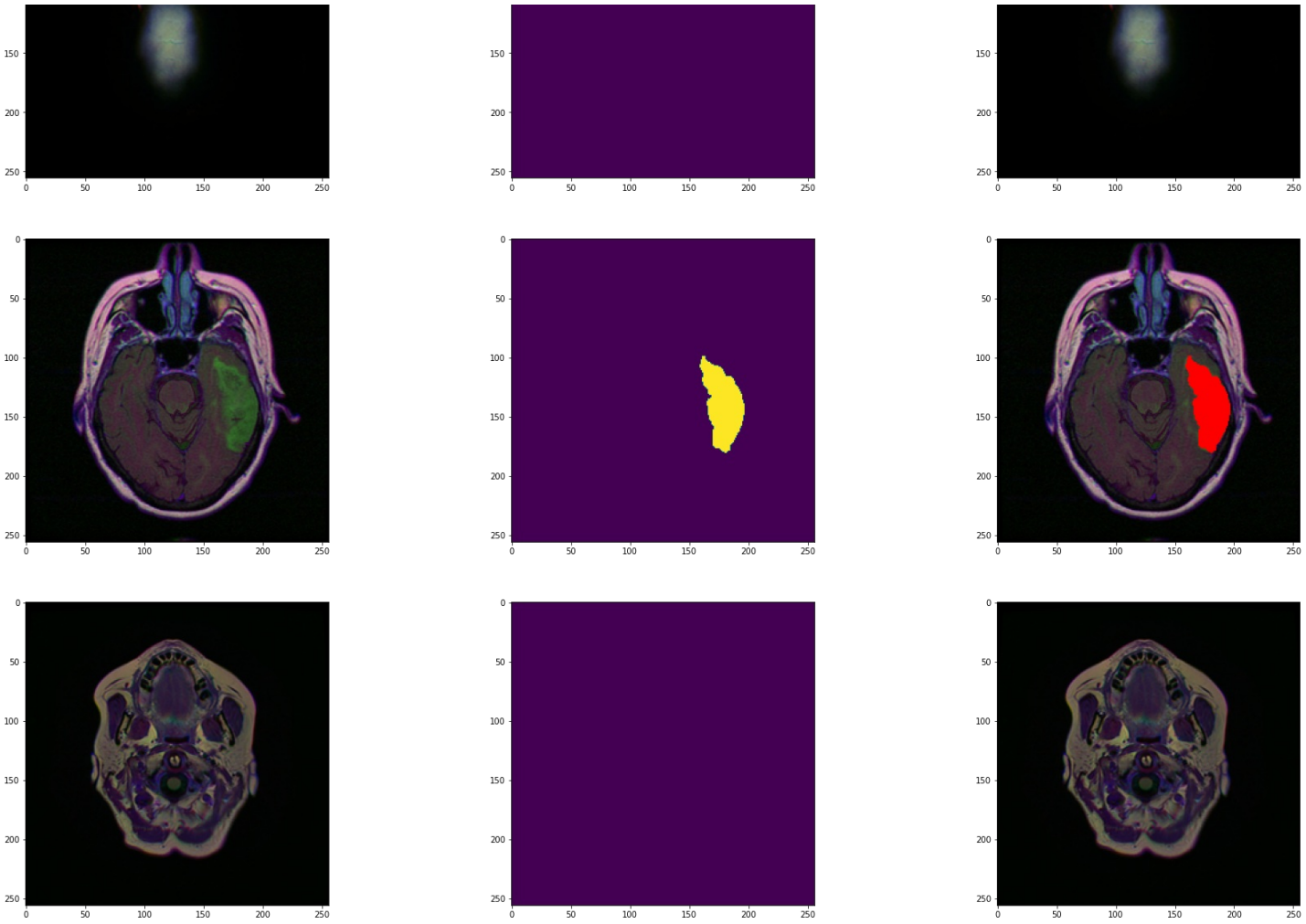
```
fig,ax=plt.subplots(10,2,figsize=(15,80))
for i in range(10):
  no=random.randint(1,len(data))
  ax[i][1].imshow(imread('/content/gdrive/MyDrive/Brain_MRI/'+data['mask_path'].iloc[no]
))
  ax[i][0].imshow(imread('/content/gdrive/MyDrive/Brain_MRI/'+data['image_path'].iloc[no
]))
```

In [ ]:

```
fig,ax=plt.subplots(10,3,figsize=(30,80))
for i in range(10):
  no=random.randint(1,len(data))
  mask=imread('/content/gdrive/MyDrive/Brain_MRI/'+data['mask_path'].iloc[no])
  ax[i][1].imshow(mask)
  image=imread('/content/gdrive/MyDrive/Brain_MRI/'+data['image_path'].iloc[no])
  ax[i][0].imshow(image)
  im=image.copy()
  im[mask==255]=(255,0,0)
  ax[i][2].imshow(im)
```







In [ ]:

```
data=data.drop('patient_id',axis=1)
```

In [ ]:

```
type(data['mask'].iloc[0])
```

Out[ ]:

```
numpy.int64
```

In [ ]:

```
data['mask']=data['mask'].apply(lambda x:str(x)).iloc[0]
```

In [ ]:

```
type(data['mask'].iloc[0])
```

Out[ ]:

```
str
```

In [ ]:

```
from sklearn.model_selection import train_test_split
train,test=train_test_split(data,test_size=0.15)
#dividing into train test validation
```

In [ ]:

```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
datagen=ImageDataGenerator(rescale=1./255.,validation_split=0.15)
#validation split is of 0.15% of train split
```

In [ ]:

```
traingen=datagen.flow_from_dataframe(train,
              directory='/content/gdrive/MyDrive/Brain_MRI/',
              batch_size=16,class_mode='categorical',subset='training',
              shuffle=True,target_size=(256,256),x_col='image_path',y_col='mask')
```

```
Found 2485 validated image filenames belonging to 1 classes.
```

```
/usr/local/lib/python3.6/dist-packages/keras_preprocessing/image/dataframe_iterator.py:28
2: UserWarning: Found 416 invalid image filename(s) in x_col="image_path". These filename
(s) will be ignored.
  .format(n_invalid, x_col)
```

In [ ]:

```
#validation ->0.15 of train
validation=datagen.flow_from_dataframe(train,
    batch_size=16,x_col='image_path',
    y_col='mask',target_size=(255,255),
    subset='validation',class_mode='categorical',shuffle=True,
    directory='/content/gdrive/MyDrive/Brain_MRI/'

)
```

```
Found 438 validated image filenames belonging to 1 classes.
```

```
/usr/local/lib/python3.6/dist-packages/keras_preprocessing/image/dataframe_iterator.py:28
2: UserWarning: Found 416 invalid image filename(s) in x_col="image_path". These filename
(s) will be ignored.
  .format(n_invalid, x_col)
```

In [ ]:

```
#test 0.15 of total
testg=ImageDataGenerator(rescale=1./255.)
testgen=testg.flow_from_dataframe(test,class_mode='categorical',
                x_col='image_path',y_col='mask',shuffle=False,target_size=(255,255),batc
h_size=16,
                directory='/content/gdrive/MyDrive/Brain_MRI/')
```

```
Found 505 validated image filenames belonging to 1 classes.
```

```
/usr/local/lib/python3.6/dist-packages/keras_preprocessing/image/dataframe_iterator.py:28
2: UserWarning: Found 85 invalid image filename(s) in x_col="image_path". These filename(
s) will be ignored.
  .format(n_invalid, x_col)
```

In [ ]:

```
#transfer learning
from tensorflow.keras.applications.resnet50 import ResNet50
from tensorflow.keras import layers,optimizers
from tensorflow.keras.models import Sequential,load_model,Model
from tensorflow.keras.callbacks import EarlyStopping,ModelCheckpoint,ReduceLROnPlateau,Le
arningRateScheduler
from tensorflow.keras.layers import *
from tensorflow.keras import Input
```

In [ ]:

```
baselayer=ResNet50(weights = 'imagenet', include_top = False, input_tensor = Input(shape
=(256, 256, 3)))
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/resnet
/resnet50_weights_tf_dim_ordering_tf_kernels_notop.h5
94773248/94765736 [==============================] - 1s 0us/step
```

In [ ]:

```
baselayer.summary()
```

```
Model: "resnet50"
__________________________________________________________________________________________
```

```
__________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
=========
input_1 (InputLayer)            [(None, 256, 256, 3) 0

__________________________________________________________________________________________________
__________
conv1_pad (ZeroPadding2D)       (None, 262, 262, 3)  0           input_1[0][0]

__________________________________________________________________________________________________
__________
conv1_conv (Conv2D)             (None, 128, 128, 64) 9472        conv1_pad[0][0]

__________________________________________________________________________________________________
__________
conv1_bn (BatchNormalization)   (None, 128, 128, 64) 256         conv1_conv[0][0]

__________________________________________________________________________________________________
__________
conv1_relu (Activation)         (None, 128, 128, 64) 0           conv1_bn[0][0]

__________________________________________________________________________________________________
__________
pool1_pad (ZeroPadding2D)       (None, 130, 130, 64) 0           conv1_relu[0][0]

__________________________________________________________________________________________________
__________
pool1_pool (MaxPooling2D)       (None, 64, 64, 64)   0           pool1_pad[0][0]

__________________________________________________________________________________________________
__________
conv2_block1_1_conv (Conv2D)    (None, 64, 64, 64)   4160        pool1_pool[0][0]

__________________________________________________________________________________________________
__________
conv2_block1_1_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block1_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv2_block1_1_relu (Activation (None, 64, 64, 64)   0           conv2_block1_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv2_block1_2_conv (Conv2D)    (None, 64, 64, 64)   36928       conv2_block1_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv2_block1_2_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block1_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv2_block1_2_relu (Activation (None, 64, 64, 64)   0           conv2_block1_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv2_block1_0_conv (Conv2D)    (None, 64, 64, 256)  16640       pool1_pool[0][0]

__________________________________________________________________________________________________
__________
conv2_block1_3_conv (Conv2D)    (None, 64, 64, 256)  16640       conv2_block1_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv2_block1_0_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block1_0_conv[0][0
]
__________________________________________________________________________________________________
__________
conv2_block1_3_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block1_3_conv[0][0
]
__________________________________________________________________________________________________
```

```
__________
conv2_block1_add (Add)          (None, 64, 64, 256)  0           conv2_block1_0_bn[0][0]
                                                                 conv2_block1_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv2_block1_out (Activation)   (None, 64, 64, 256)  0           conv2_block1_add[0][0]
__________________________________________________________________________________________
__________
conv2_block2_1_conv (Conv2D)    (None, 64, 64, 64)   16448       conv2_block1_out[0][0]
__________________________________________________________________________________________
__________
conv2_block2_1_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block2_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_1_relu (Activation (None, 64, 64, 64)   0           conv2_block2_1_bn[0][0]
__________________________________________________________________________________________
__________
conv2_block2_2_conv (Conv2D)    (None, 64, 64, 64)   36928       conv2_block2_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_2_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block2_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_2_relu (Activation (None, 64, 64, 64)   0           conv2_block2_2_bn[0][0]
__________________________________________________________________________________________
__________
conv2_block2_3_conv (Conv2D)    (None, 64, 64, 256)  16640       conv2_block2_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_3_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block2_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_add (Add)          (None, 64, 64, 256)  0           conv2_block1_out[0][0]
                                                                 conv2_block2_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv2_block2_out (Activation)   (None, 64, 64, 256)  0           conv2_block2_add[0][0]
__________________________________________________________________________________________
__________
conv2_block3_1_conv (Conv2D)    (None, 64, 64, 64)   16448       conv2_block2_out[0][0]
__________________________________________________________________________________________
__________
conv2_block3_1_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block3_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_1_relu (Activation (None, 64, 64, 64)   0           conv2_block3_1_bn[0][0]
__________________________________________________________________________________________
__________
conv2_block3_2_conv (Conv2D)    (None, 64, 64, 64)   36928       conv2_block3_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_2_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block3_2_conv[0][0
]
__________________________________________________________________________________________
```

```
__________
conv2_block3_2_relu (Activation (None, 64, 64, 64)   0           conv2_block3_2_bn[0][0]

__________________________________________________________________________________________
__________
conv2_block3_3_conv (Conv2D)    (None, 64, 64, 256)  16640       conv2_block3_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_3_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block3_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_add (Add)          (None, 64, 64, 256)  0           conv2_block2_out[0][0]

                                                                 conv2_block3_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv2_block3_out (Activation)   (None, 64, 64, 256)  0           conv2_block3_add[0][0]

__________________________________________________________________________________________
__________
conv3_block1_1_conv (Conv2D)    (None, 32, 32, 128)  32896       conv2_block3_out[0][0]

__________________________________________________________________________________________
__________
conv3_block1_1_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block1_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_1_relu (Activation (None, 32, 32, 128)  0           conv3_block1_1_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block1_2_conv (Conv2D)    (None, 32, 32, 128)  147584      conv3_block1_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_2_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block1_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_2_relu (Activation (None, 32, 32, 128)  0           conv3_block1_2_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block1_0_conv (Conv2D)    (None, 32, 32, 512)  131584      conv2_block3_out[0][0]

__________________________________________________________________________________________
__________
conv3_block1_3_conv (Conv2D)    (None, 32, 32, 512)  66048       conv3_block1_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_0_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block1_0_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_3_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block1_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_add (Add)          (None, 32, 32, 512)  0           conv3_block1_0_bn[0][0]

                                                                 conv3_block1_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv3_block1_out (Activation)   (None, 32, 32, 512)  0           conv3_block1_add[0][0]

__________________________________________________________________________________________
```

```
__________
conv3_block2_1_conv (Conv2D)    (None, 32, 32, 128)  65664       conv3_block1_out[0][0]

__________________________________________________________________________________________
__________
conv3_block2_1_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block2_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_1_relu (Activation (None, 32, 32, 128)  0           conv3_block2_1_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block2_2_conv (Conv2D)    (None, 32, 32, 128)  147584      conv3_block2_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_2_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block2_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_2_relu (Activation (None, 32, 32, 128)  0           conv3_block2_2_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block2_3_conv (Conv2D)    (None, 32, 32, 512)  66048       conv3_block2_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_3_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block2_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_add (Add)          (None, 32, 32, 512)  0           conv3_block1_out[0][0]

                                                                 conv3_block2_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_out (Activation)   (None, 32, 32, 512)  0           conv3_block2_add[0][0]

__________________________________________________________________________________________
__________
conv3_block3_1_conv (Conv2D)    (None, 32, 32, 128)  65664       conv3_block2_out[0][0]

__________________________________________________________________________________________
__________
conv3_block3_1_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block3_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_1_relu (Activation (None, 32, 32, 128)  0           conv3_block3_1_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block3_2_conv (Conv2D)    (None, 32, 32, 128)  147584      conv3_block3_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_2_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block3_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_2_relu (Activation (None, 32, 32, 128)  0           conv3_block3_2_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block3_3_conv (Conv2D)    (None, 32, 32, 512)  66048       conv3_block3_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_3_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block3_3_conv[0][0
]
```

]
____
conv3_block3_add (Add)   (None, 32, 32, 512) 0   conv3_block2_out[0][0]
                                                                 conv3_block3_3_bn[0][0
]
____
conv3_block3_out (Activation)   (None, 32, 32, 512) 0   conv3_block3_add[0][0]

____
conv3_block4_1_conv (Conv2D)   (None, 32, 32, 128) 65664   conv3_block3_out[0][0]

____
conv3_block4_1_bn (BatchNormali (None, 32, 32, 128) 512   conv3_block4_1_conv[0][0
]
____
conv3_block4_1_relu (Activation (None, 32, 32, 128) 0   conv3_block4_1_bn[0][0]

____
conv3_block4_2_conv (Conv2D)   (None, 32, 32, 128) 147584   conv3_block4_1_relu[0][0
]
____
conv3_block4_2_bn (BatchNormali (None, 32, 32, 128) 512   conv3_block4_2_conv[0][0
]
____
conv3_block4_2_relu (Activation (None, 32, 32, 128) 0   conv3_block4_2_bn[0][0]

____
conv3_block4_3_conv (Conv2D)   (None, 32, 32, 512) 66048   conv3_block4_2_relu[0][0
]
____
conv3_block4_3_bn (BatchNormali (None, 32, 32, 512) 2048   conv3_block4_3_conv[0][0
]
____
conv3_block4_add (Add)   (None, 32, 32, 512) 0   conv3_block3_out[0][0]
                                                                 conv3_block4_3_bn[0][0
]
____
conv3_block4_out (Activation)   (None, 32, 32, 512) 0   conv3_block4_add[0][0]

____
conv4_block1_1_conv (Conv2D)   (None, 16, 16, 256) 131328   conv3_block4_out[0][0]

____
conv4_block1_1_bn (BatchNormali (None, 16, 16, 256) 1024   conv4_block1_1_conv[0][0
]
____
conv4_block1_1_relu (Activation (None, 16, 16, 256) 0   conv4_block1_1_bn[0][0]

____
conv4_block1_2_conv (Conv2D)   (None, 16, 16, 256) 590080   conv4_block1_1_relu[0][0
]
____
conv4_block1_2_bn (BatchNormali (None, 16, 16, 256) 1024   conv4_block1_2_conv[0][0
]

```
]
__________________________________________________________________________________________________
__________
conv4_block1_2_relu (Activation (None, 16, 16, 256)  0           conv4_block1_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block1_0_conv (Conv2D)    (None, 16, 16, 1024) 525312      conv3_block4_out[0][0]

__________________________________________________________________________________________________
__________
conv4_block1_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block1_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block1_0_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block1_0_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block1_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block1_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block1_add (Add)          (None, 16, 16, 1024) 0           conv4_block1_0_bn[0][0]
                                                                 conv4_block1_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv4_block1_out (Activation)   (None, 16, 16, 1024) 0           conv4_block1_add[0][0]

__________________________________________________________________________________________________
__________
conv4_block2_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block1_out[0][0]

__________________________________________________________________________________________________
__________
conv4_block2_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block2_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_1_relu (Activation (None, 16, 16, 256)  0           conv4_block2_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block2_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block2_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block2_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_2_relu (Activation (None, 16, 16, 256)  0           conv4_block2_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block2_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block2_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block2_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_add (Add)          (None, 16, 16, 1024) 0           conv4_block1_out[0][0]
                                                                 conv4_block2_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv4_block2_out (Activation)   (None, 16, 16, 1024) 0           conv4_block2_add[0][0]
```

```
__________________________________________________________________________________________________
__________
conv4_block3_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block2_out[0][0]

__________________________________________________________________________________________________
__________
conv4_block3_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block3_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_1_relu (Activation (None, 16, 16, 256)  0           conv4_block3_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block3_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block3_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block3_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_2_relu (Activation (None, 16, 16, 256)  0           conv4_block3_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block3_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block3_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block3_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_add (Add)          (None, 16, 16, 1024) 0           conv4_block2_out[0][0]

                                                                 conv4_block3_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_out (Activation)   (None, 16, 16, 1024) 0           conv4_block3_add[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block3_out[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block4_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_1_relu (Activation (None, 16, 16, 256)  0           conv4_block4_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block4_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block4_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_2_relu (Activation (None, 16, 16, 256)  0           conv4_block4_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block4_2_relu[0][0
]
__________________________________________________________________________________________________
```

```
__________
conv4_block4_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block4_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block4_add (Add)          (None, 16, 16, 1024) 0           conv4_block3_out[0][0]
                                                                 conv4_block4_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv4_block4_out (Activation)   (None, 16, 16, 1024) 0           conv4_block4_add[0][0]
__________________________________________________________________________________________
__________
conv4_block5_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block4_out[0][0]
__________________________________________________________________________________________
__________
conv4_block5_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block5_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_1_relu (Activation (None, 16, 16, 256)  0           conv4_block5_1_bn[0][0]
__________________________________________________________________________________________
__________
conv4_block5_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block5_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block5_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_2_relu (Activation (None, 16, 16, 256)  0           conv4_block5_2_bn[0][0]
__________________________________________________________________________________________
__________
conv4_block5_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block5_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block5_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_add (Add)          (None, 16, 16, 1024) 0           conv4_block4_out[0][0]
                                                                 conv4_block5_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv4_block5_out (Activation)   (None, 16, 16, 1024) 0           conv4_block5_add[0][0]
__________________________________________________________________________________________
__________
conv4_block6_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block5_out[0][0]
__________________________________________________________________________________________
__________
conv4_block6_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block6_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_1_relu (Activation (None, 16, 16, 256)  0           conv4_block6_1_bn[0][0]
__________________________________________________________________________________________
__________
conv4_block6_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block6_1_relu[0][0
]
__________________________________________________________________________________________
```

```
__________
conv4_block6_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block6_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_2_relu (Activation (None, 16, 16, 256)  0           conv4_block6_2_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block6_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block6_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block6_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_add (Add)          (None, 16, 16, 1024) 0           conv4_block5_out[0][0]

                                                                 conv4_block6_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv4_block6_out (Activation)   (None, 16, 16, 1024) 0           conv4_block6_add[0][0]

__________________________________________________________________________________________
__________
conv5_block1_1_conv (Conv2D)    (None, 8, 8, 512)    524800      conv4_block6_out[0][0]

__________________________________________________________________________________________
__________
conv5_block1_1_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block1_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_1_relu (Activation (None, 8, 8, 512)    0           conv5_block1_1_bn[0][0]

__________________________________________________________________________________________
__________
conv5_block1_2_conv (Conv2D)    (None, 8, 8, 512)    2359808     conv5_block1_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_2_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block1_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_2_relu (Activation (None, 8, 8, 512)    0           conv5_block1_2_bn[0][0]

__________________________________________________________________________________________
__________
conv5_block1_0_conv (Conv2D)    (None, 8, 8, 2048)   2099200     conv4_block6_out[0][0]

__________________________________________________________________________________________
__________
conv5_block1_3_conv (Conv2D)    (None, 8, 8, 2048)   1050624     conv5_block1_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_0_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block1_0_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_3_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block1_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block1_add (Add)          (None, 8, 8, 2048)   0           conv5_block1_0_bn[0][0]

                                                                 conv5_block1_3_bn[0][0
]
__________________________________________________________________________________________
```

```
__________
conv5_block1_out (Activation)   (None, 8, 8, 2048)   0           conv5_block1_add[0][0]

__________________________________________________________________________________________
__________
conv5_block2_1_conv (Conv2D)    (None, 8, 8, 512)    1049088     conv5_block1_out[0][0]

__________________________________________________________________________________________
__________
conv5_block2_1_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block2_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block2_1_relu (Activation (None, 8, 8, 512)    0           conv5_block2_1_bn[0][0]

__________________________________________________________________________________________
__________
conv5_block2_2_conv (Conv2D)    (None, 8, 8, 512)    2359808     conv5_block2_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv5_block2_2_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block2_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block2_2_relu (Activation (None, 8, 8, 512)    0           conv5_block2_2_bn[0][0]

__________________________________________________________________________________________
__________
conv5_block2_3_conv (Conv2D)    (None, 8, 8, 2048)   1050624     conv5_block2_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv5_block2_3_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block2_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block2_add (Add)          (None, 8, 8, 2048)   0           conv5_block1_out[0][0]
                                                                 conv5_block2_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv5_block2_out (Activation)   (None, 8, 8, 2048)   0           conv5_block2_add[0][0]

__________________________________________________________________________________________
__________
conv5_block3_1_conv (Conv2D)    (None, 8, 8, 512)    1049088     conv5_block2_out[0][0]

__________________________________________________________________________________________
__________
conv5_block3_1_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block3_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block3_1_relu (Activation (None, 8, 8, 512)    0           conv5_block3_1_bn[0][0]

__________________________________________________________________________________________
__________
conv5_block3_2_conv (Conv2D)    (None, 8, 8, 512)    2359808     conv5_block3_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv5_block3_2_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block3_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv5_block3_2_relu (Activation (None, 8, 8, 512)    0           conv5_block3_2_bn[0][0]

__________________________________________________________________________________________
__________
conv5_block3_3_conv (Conv2D)    (None, 8, 8, 2048)   1050624     conv5_block3_2_relu[0][0
]
```

```
]
__________________________________________________________________________________________________
__________
conv5_block3_3_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block3_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block3_add (Add)          (None, 8, 8, 2048)   0           conv5_block2_out[0][0]

                                                                 conv5_block3_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv5_block3_out (Activation)   (None, 8, 8, 2048)   0           conv5_block3_add[0][0]

==================================================================================================
=========
Total params: 23,587,712
Trainable params: 23,534,592
Non-trainable params: 53,120
__________________________________________________________________________________________________
__________
```

In [ ]:

```
for layer in baselayer.layers:
  layers.trainable=False
```

In [ ]:

```
final_layer=baselayer.output
final_layer=AveragePooling2D(pool_size=(4,4))(final_layer)
final_layer=Flatten(name='flatten')(final_layer)
final_layer=Dense(256,activation='relu')(final_layer)
final_layer=Dropout(0.3)(final_layer)
final_layer=Dense(256,activation='relu')(final_layer)
final_layer=Dropout(0.3)(final_layer)
final_layer=Dense(2,activation='softmax')(final_layer)

model=Model(inputs=baselayer.input, outputs=final_layer)
```

In [ ]:

```
model.summary()
```

```
Model: "model"
__________________________________________________________________________________________________
__________
Layer (type)                    Output Shape         Param #     Connected to

==================================================================================================
=========
input_1 (InputLayer)            [(None, 256, 256, 3) 0

__________________________________________________________________________________________________
__________
conv1_pad (ZeroPadding2D)       (None, 262, 262, 3)  0           input_1[0][0]

__________________________________________________________________________________________________
__________
conv1_conv (Conv2D)             (None, 128, 128, 64) 9472        conv1_pad[0][0]

__________________________________________________________________________________________________
__________
conv1_bn (BatchNormalization)   (None, 128, 128, 64) 256         conv1_conv[0][0]

__________________________________________________________________________________________________
__________
conv1_relu (Activation)         (None, 128, 128, 64) 0           conv1_bn[0][0]

__________________________________________________________________________________________________
__________
```

```
pool1_pad (ZeroPadding2D)       (None, 130, 130, 64) 0           conv1_relu[0][0]
__________________________________________________________________________________________________
pool1_pool (MaxPooling2D)       (None, 64, 64, 64)   0           pool1_pad[0][0]
__________________________________________________________________________________________________
conv2_block1_1_conv (Conv2D)    (None, 64, 64, 64)   4160        pool1_pool[0][0]
__________________________________________________________________________________________________
conv2_block1_1_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block1_1_conv[0][0
]
__________________________________________________________________________________________________
conv2_block1_1_relu (Activation (None, 64, 64, 64)   0           conv2_block1_1_bn[0][0]
__________________________________________________________________________________________________
conv2_block1_2_conv (Conv2D)    (None, 64, 64, 64)   36928       conv2_block1_1_relu[0][0
]
__________________________________________________________________________________________________
conv2_block1_2_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block1_2_conv[0][0
]
__________________________________________________________________________________________________
conv2_block1_2_relu (Activation (None, 64, 64, 64)   0           conv2_block1_2_bn[0][0]
__________________________________________________________________________________________________
conv2_block1_0_conv (Conv2D)    (None, 64, 64, 256)  16640       pool1_pool[0][0]
__________________________________________________________________________________________________
conv2_block1_3_conv (Conv2D)    (None, 64, 64, 256)  16640       conv2_block1_2_relu[0][0
]
__________________________________________________________________________________________________
conv2_block1_0_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block1_0_conv[0][0
]
__________________________________________________________________________________________________
conv2_block1_3_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block1_3_conv[0][0
]
__________________________________________________________________________________________________
conv2_block1_add (Add)          (None, 64, 64, 256)  0           conv2_block1_0_bn[0][0]
                                                                 conv2_block1_3_bn[0][0
]
__________________________________________________________________________________________________
conv2_block1_out (Activation)   (None, 64, 64, 256)  0           conv2_block1_add[0][0]
__________________________________________________________________________________________________
conv2_block2_1_conv (Conv2D)    (None, 64, 64, 64)   16448       conv2_block1_out[0][0]
__________________________________________________________________________________________________
conv2_block2_1_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block2_1_conv[0][0
]
__________________________________________________________________________________________________
conv2_block2_1_relu (Activation (None, 64, 64, 64)   0           conv2_block2_1_bn[0][0]
__________________________________________________________________________________________________
conv2_block2_2_conv (Conv2D)    (None, 64, 64, 64)   36928       conv2_block2_1_relu[0][0
]
```

```
__________
conv2_block2_2_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block2_2_conv[0][0
]
__________
conv2_block2_2_relu (Activation (None, 64, 64, 64)   0           conv2_block2_2_bn[0][0]

__________
conv2_block2_3_conv (Conv2D)    (None, 64, 64, 256)  16640       conv2_block2_2_relu[0][0
]
__________
conv2_block2_3_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block2_3_conv[0][0
]
__________
conv2_block2_add (Add)          (None, 64, 64, 256)  0           conv2_block1_out[0][0]

                                                                 conv2_block2_3_bn[0][0
]
__________
conv2_block2_out (Activation)   (None, 64, 64, 256)  0           conv2_block2_add[0][0]

__________
conv2_block3_1_conv (Conv2D)    (None, 64, 64, 64)   16448       conv2_block2_out[0][0]

__________
conv2_block3_1_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block3_1_conv[0][0
]
__________
conv2_block3_1_relu (Activation (None, 64, 64, 64)   0           conv2_block3_1_bn[0][0]

__________
conv2_block3_2_conv (Conv2D)    (None, 64, 64, 64)   36928       conv2_block3_1_relu[0][0
]
__________
conv2_block3_2_bn (BatchNormali (None, 64, 64, 64)   256         conv2_block3_2_conv[0][0
]
__________
conv2_block3_2_relu (Activation (None, 64, 64, 64)   0           conv2_block3_2_bn[0][0]

__________
conv2_block3_3_conv (Conv2D)    (None, 64, 64, 256)  16640       conv2_block3_2_relu[0][0
]
__________
conv2_block3_3_bn (BatchNormali (None, 64, 64, 256)  1024        conv2_block3_3_conv[0][0
]
__________
conv2_block3_add (Add)          (None, 64, 64, 256)  0           conv2_block2_out[0][0]

                                                                 conv2_block3_3_bn[0][0
]
__________
conv2_block3_out (Activation)   (None, 64, 64, 256)  0           conv2_block3_add[0][0]

__________
conv3_block1_1_conv (Conv2D)    (None, 32, 32, 128)  32896       conv2_block3_out[0][0]
```

```
__________________________________________________________________________________________________
__________
conv3_block1_1_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block1_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block1_1_relu (Activation (None, 32, 32, 128)  0           conv3_block1_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block1_2_conv (Conv2D)    (None, 32, 32, 128)  147584      conv3_block1_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block1_2_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block1_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block1_2_relu (Activation (None, 32, 32, 128)  0           conv3_block1_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block1_0_conv (Conv2D)    (None, 32, 32, 512)  131584      conv2_block3_out[0][0]

__________________________________________________________________________________________________
__________
conv3_block1_3_conv (Conv2D)    (None, 32, 32, 512)  66048       conv3_block1_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block1_0_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block1_0_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block1_3_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block1_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block1_add (Add)          (None, 32, 32, 512)  0           conv3_block1_0_bn[0][0]

                                                                 conv3_block1_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv3_block1_out (Activation)   (None, 32, 32, 512)  0           conv3_block1_add[0][0]

__________________________________________________________________________________________________
__________
conv3_block2_1_conv (Conv2D)    (None, 32, 32, 128)  65664       conv3_block1_out[0][0]

__________________________________________________________________________________________________
__________
conv3_block2_1_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block2_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block2_1_relu (Activation (None, 32, 32, 128)  0           conv3_block2_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv3_block2_2_conv (Conv2D)    (None, 32, 32, 128)  147584      conv3_block2_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv3_block2_2_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block2_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv3_block2_2_relu (Activation (None, 32, 32, 128)  0           conv3_block2_2_bn[0][0]

__________________________________________________________________________________________________
__________
```

```
conv3_block2_3_conv (Conv2D)    (None, 32, 32, 512)  66048       conv3_block2_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_3_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block2_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_add (Add)          (None, 32, 32, 512)  0           conv3_block1_out[0][0]

                                                                 conv3_block2_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv3_block2_out (Activation)   (None, 32, 32, 512)  0           conv3_block2_add[0][0]

__________________________________________________________________________________________
__________
conv3_block3_1_conv (Conv2D)    (None, 32, 32, 128)  65664       conv3_block2_out[0][0]

__________________________________________________________________________________________
__________
conv3_block3_1_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block3_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_1_relu (Activation (None, 32, 32, 128)  0           conv3_block3_1_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block3_2_conv (Conv2D)    (None, 32, 32, 128)  147584      conv3_block3_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_2_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block3_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_2_relu (Activation (None, 32, 32, 128)  0           conv3_block3_2_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block3_3_conv (Conv2D)    (None, 32, 32, 512)  66048       conv3_block3_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_3_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block3_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_add (Add)          (None, 32, 32, 512)  0           conv3_block2_out[0][0]

                                                                 conv3_block3_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv3_block3_out (Activation)   (None, 32, 32, 512)  0           conv3_block3_add[0][0]

__________________________________________________________________________________________
__________
conv3_block4_1_conv (Conv2D)    (None, 32, 32, 128)  65664       conv3_block3_out[0][0]

__________________________________________________________________________________________
__________
conv3_block4_1_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block4_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block4_1_relu (Activation (None, 32, 32, 128)  0           conv3_block4_1_bn[0][0]

__________________________________________________________________________________________
__________
```

```
conv3_block4_2_conv (Conv2D)    (None, 32, 32, 128)  147584      conv3_block4_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block4_2_bn (BatchNormali (None, 32, 32, 128)  512         conv3_block4_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block4_2_relu (Activation (None, 32, 32, 128)  0           conv3_block4_2_bn[0][0]

__________________________________________________________________________________________
__________
conv3_block4_3_conv (Conv2D)    (None, 32, 32, 512)  66048       conv3_block4_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv3_block4_3_bn (BatchNormali (None, 32, 32, 512)  2048        conv3_block4_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv3_block4_add (Add)          (None, 32, 32, 512)  0           conv3_block3_out[0][0]

                                                                 conv3_block4_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv3_block4_out (Activation)   (None, 32, 32, 512)  0           conv3_block4_add[0][0]

__________________________________________________________________________________________
__________
conv4_block1_1_conv (Conv2D)    (None, 16, 16, 256)  131328      conv3_block4_out[0][0]

__________________________________________________________________________________________
__________
conv4_block1_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block1_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block1_1_relu (Activation (None, 16, 16, 256)  0           conv4_block1_1_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block1_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block1_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block1_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block1_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block1_2_relu (Activation (None, 16, 16, 256)  0           conv4_block1_2_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block1_0_conv (Conv2D)    (None, 16, 16, 1024) 525312      conv3_block4_out[0][0]

__________________________________________________________________________________________
__________
conv4_block1_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block1_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block1_0_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block1_0_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block1_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block1_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block1_add (Add)          (None, 16, 16, 1024) 0           conv4_block1_0_bn[0][0]
```

```
                                                                 conv4_block1_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv4_block1_out (Activation)   (None, 16, 16, 1024) 0           conv4_block1_add[0][0]

__________________________________________________________________________________________
__________
conv4_block2_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block1_out[0][0]

__________________________________________________________________________________________
__________
conv4_block2_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block2_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block2_1_relu (Activation (None, 16, 16, 256)  0           conv4_block2_1_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block2_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block2_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block2_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block2_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block2_2_relu (Activation (None, 16, 16, 256)  0           conv4_block2_2_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block2_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block2_2_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block2_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block2_3_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block2_add (Add)          (None, 16, 16, 1024) 0           conv4_block1_out[0][0]
                                                                 conv4_block2_3_bn[0][0
]
__________________________________________________________________________________________
__________
conv4_block2_out (Activation)   (None, 16, 16, 1024) 0           conv4_block2_add[0][0]

__________________________________________________________________________________________
__________
conv4_block3_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block2_out[0][0]

__________________________________________________________________________________________
__________
conv4_block3_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block3_1_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block3_1_relu (Activation (None, 16, 16, 256)  0           conv4_block3_1_bn[0][0]

__________________________________________________________________________________________
__________
conv4_block3_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block3_1_relu[0][0
]
__________________________________________________________________________________________
__________
conv4_block3_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block3_2_conv[0][0
]
__________________________________________________________________________________________
__________
conv4_block3_2_relu (Activation (None, 16, 16, 256)  0           conv4_block3_2_bn[0][0]
```

```
__________________________________________________________________________________________________
__________
conv4_block3_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block3_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block3_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_add (Add)          (None, 16, 16, 1024) 0           conv4_block2_out[0][0]

                                                                 conv4_block3_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv4_block3_out (Activation)   (None, 16, 16, 1024) 0           conv4_block3_add[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block3_out[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block4_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_1_relu (Activation (None, 16, 16, 256)  0           conv4_block4_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block4_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block4_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_2_relu (Activation (None, 16, 16, 256)  0           conv4_block4_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block4_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block4_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block4_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_add (Add)          (None, 16, 16, 1024) 0           conv4_block3_out[0][0]

                                                                 conv4_block4_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv4_block4_out (Activation)   (None, 16, 16, 1024) 0           conv4_block4_add[0][0]

__________________________________________________________________________________________________
__________
conv4_block5_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block4_out[0][0]

__________________________________________________________________________________________________
__________
conv4_block5_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block5_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block5_1_relu (Activation (None, 16, 16, 256)  0           conv4_block5_1_bn[0][0]
```

```
__________________________________________________________________________________________________
__________
conv4_block5_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block5_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block5_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block5_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block5_2_relu (Activation (None, 16, 16, 256)  0           conv4_block5_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block5_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block5_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block5_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block5_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block5_add (Add)          (None, 16, 16, 1024) 0           conv4_block4_out[0][0]

                                                                 conv4_block5_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv4_block5_out (Activation)   (None, 16, 16, 1024) 0           conv4_block5_add[0][0]

__________________________________________________________________________________________________
__________
conv4_block6_1_conv (Conv2D)    (None, 16, 16, 256)  262400      conv4_block5_out[0][0]

__________________________________________________________________________________________________
__________
conv4_block6_1_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block6_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block6_1_relu (Activation (None, 16, 16, 256)  0           conv4_block6_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block6_2_conv (Conv2D)    (None, 16, 16, 256)  590080      conv4_block6_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block6_2_bn (BatchNormali (None, 16, 16, 256)  1024        conv4_block6_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block6_2_relu (Activation (None, 16, 16, 256)  0           conv4_block6_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv4_block6_3_conv (Conv2D)    (None, 16, 16, 1024) 263168      conv4_block6_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv4_block6_3_bn (BatchNormali (None, 16, 16, 1024) 4096        conv4_block6_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv4_block6_add (Add)          (None, 16, 16, 1024) 0           conv4_block5_out[0][0]

                                                                 conv4_block6_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv4_block6_out (Activation)   (None, 16, 16, 1024) 0           conv4_block6_add[0][0]
```

```
__________________________________________________________________________________________________
__________
conv5_block1_1_conv (Conv2D)    (None, 8, 8, 512)    524800      conv4_block6_out[0][0]

__________________________________________________________________________________________________
__________
conv5_block1_1_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block1_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block1_1_relu (Activation (None, 8, 8, 512)    0           conv5_block1_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv5_block1_2_conv (Conv2D)    (None, 8, 8, 512)    2359808     conv5_block1_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv5_block1_2_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block1_2_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block1_2_relu (Activation (None, 8, 8, 512)    0           conv5_block1_2_bn[0][0]

__________________________________________________________________________________________________
__________
conv5_block1_0_conv (Conv2D)    (None, 8, 8, 2048)   2099200     conv4_block6_out[0][0]

__________________________________________________________________________________________________
__________
conv5_block1_3_conv (Conv2D)    (None, 8, 8, 2048)   1050624     conv5_block1_2_relu[0][0
]
__________________________________________________________________________________________________
__________
conv5_block1_0_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block1_0_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block1_3_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block1_3_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block1_add (Add)          (None, 8, 8, 2048)   0           conv5_block1_0_bn[0][0]
                                                                 conv5_block1_3_bn[0][0
]
__________________________________________________________________________________________________
__________
conv5_block1_out (Activation)   (None, 8, 8, 2048)   0           conv5_block1_add[0][0]

__________________________________________________________________________________________________
__________
conv5_block2_1_conv (Conv2D)    (None, 8, 8, 512)    1049088     conv5_block1_out[0][0]

__________________________________________________________________________________________________
__________
conv5_block2_1_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block2_1_conv[0][0
]
__________________________________________________________________________________________________
__________
conv5_block2_1_relu (Activation (None, 8, 8, 512)    0           conv5_block2_1_bn[0][0]

__________________________________________________________________________________________________
__________
conv5_block2_2_conv (Conv2D)    (None, 8, 8, 512)    2359808     conv5_block2_1_relu[0][0
]
__________________________________________________________________________________________________
__________
conv5_block2_2_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block2_2_conv[0][0
]
__________________________________________________________________________________________________
__________
```

```
conv5_block2_2_relu (Activation (None, 8, 8, 512)    0           conv5_block2_2_bn[0][0]
__________________________________________________________________________________________
conv5_block2_3_conv (Conv2D)    (None, 8, 8, 2048)   1050624     conv5_block2_2_relu[0][0
]
__________________________________________________________________________________________
conv5_block2_3_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block2_3_conv[0][0
]
__________________________________________________________________________________________
conv5_block2_add (Add)          (None, 8, 8, 2048)   0           conv5_block1_out[0][0]
                                                                 conv5_block2_3_bn[0][0
]
__________________________________________________________________________________________
conv5_block2_out (Activation)   (None, 8, 8, 2048)   0           conv5_block2_add[0][0]
__________________________________________________________________________________________
conv5_block3_1_conv (Conv2D)    (None, 8, 8, 512)    1049088     conv5_block2_out[0][0]
__________________________________________________________________________________________
conv5_block3_1_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block3_1_conv[0][0
]
__________________________________________________________________________________________
conv5_block3_1_relu (Activation (None, 8, 8, 512)    0           conv5_block3_1_bn[0][0]
__________________________________________________________________________________________
conv5_block3_2_conv (Conv2D)    (None, 8, 8, 512)    2359808     conv5_block3_1_relu[0][0
]
__________________________________________________________________________________________
conv5_block3_2_bn (BatchNormali (None, 8, 8, 512)    2048        conv5_block3_2_conv[0][0
]
__________________________________________________________________________________________
conv5_block3_2_relu (Activation (None, 8, 8, 512)    0           conv5_block3_2_bn[0][0]
__________________________________________________________________________________________
conv5_block3_3_conv (Conv2D)    (None, 8, 8, 2048)   1050624     conv5_block3_2_relu[0][0
]
__________________________________________________________________________________________
conv5_block3_3_bn (BatchNormali (None, 8, 8, 2048)   8192        conv5_block3_3_conv[0][0
]
__________________________________________________________________________________________
conv5_block3_add (Add)          (None, 8, 8, 2048)   0           conv5_block2_out[0][0]
                                                                 conv5_block3_3_bn[0][0
]
__________________________________________________________________________________________
conv5_block3_out (Activation)   (None, 8, 8, 2048)   0           conv5_block3_add[0][0]
__________________________________________________________________________________________
average_pooling2d (AveragePooli (None, 2, 2, 2048)   0           conv5_block3_out[0][0]
__________________________________________________________________________________________
flatten (Flatten)               (None, 8192)         0           average_pooling2d[0][0]
__________________________________________________________________________________________
```

```
dense (Dense)                   (None, 256)          2097408     flatten[0][0]

__________________________________________________________________________________________
_________
dropout (Dropout)               (None, 256)          0           dense[0][0]

__________________________________________________________________________________________
_________
dense_1 (Dense)                 (None, 256)          65792       dropout[0][0]

__________________________________________________________________________________________
_________
dropout_1 (Dropout)             (None, 256)          0           dense_1[0][0]

__________________________________________________________________________________________
_________
dense_2 (Dense)                 (None, 2)            514         dropout_1[0][0]

==========================================================================================
=========
Total params: 25,751,426
Trainable params: 25,698,306
Non-trainable params: 53,120
__________________________________________________________________________________________
_________
```

In [ ]:

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

In [ ]:

```
stop=EarlyStopping(patience=15,mode='min',monitor='val_loss')
checkpointer=ModelCheckpoint('best_model_weight.hdf5',save_best_only=True)
```

In [ ]:

```
history=model.fit(traingen,epochs=1,validation_data=validation,callbacks=[checkpointer,
stop])
```

```
156/156 [==============================] - 1323s 8s/step - loss: 6413.8307 - accuracy: 0.
4919 - val_loss: 10075.6738 - val_accuracy: 0.0000e+00
```

In [ ]:

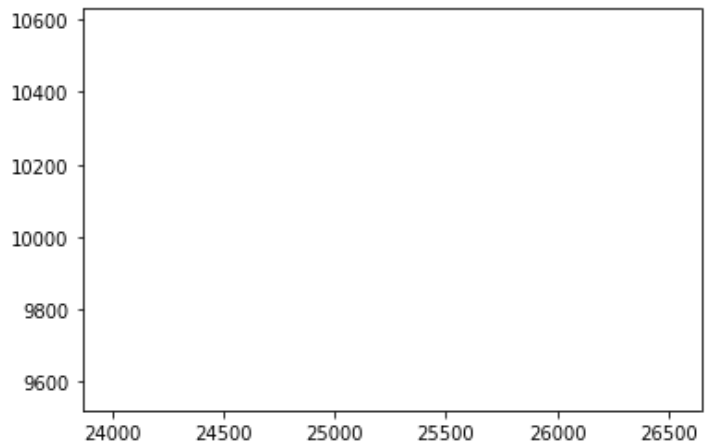
```
loss=pd.DataFrame(model.history.history)
```

In [ ]:

```
plt.plot(loss['loss'],loss['val_loss'])
```

Out[ ]:

```
[<matplotlib.lines.Line2D at 0x7f66b004f278>]
```



In [ ]:

```
loss['loss']
```

Out[ ]:

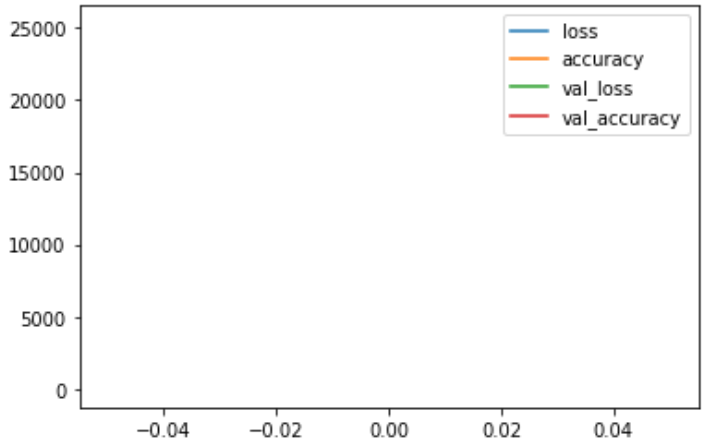
```
0    25258.009766
Name: loss, dtype: float64
```

In [ ]:

```
loss.plot()
```

Out[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f64a1dc97f0>
```



In [ ]:

```

```

In [ ]:

```

```

In [ ]:

```
from keras.preprocessing.image import ImageDataGenerator
from keras.models import Sequential
from keras.layers import Conv2D, MaxPooling2D, BatchNormalization
from keras.layers import Dense, Dropout, Flatten

from sklearn.model_selection import train_test_split
```

In [ ]:

```
model = Sequential()

# 3 Convolutional, Pooling, Dropout layers
model.add(Conv2D(8,
                 (3,3),
                 activation = 'relu',
                 input_shape = (256, 256, 3)))
model.add(MaxPooling2D(2,2))
model.add(Dropout(0.25))

model.add(Conv2D(16,
                 (3, 3),
                 activation = 'relu'))
model.add(MaxPooling2D(2,2))
model.add(Dropout(0.25))

model.add(Conv2D(32,
                 (3,3),
                 activation = 'relu'))
model.add(MaxPooling2D(2,2))
model.add(Dropout(0.25))
```

```
# Dense layers start
model.add(Flatten())

model.add(Dense(1024,
                activation = 'relu'))
model.add(Dropout(0.45))

model.add(Dense(256,
                activation = 'tanh'))
model.add(Dropout(0.45))

model.add(Dense(2,
                activation = 'sigmoid'))
model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_3 (Conv2D)            (None, 254, 254, 8)       224
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 127, 127, 8)       0
_________________________________________________________________
dropout_5 (Dropout)          (None, 127, 127, 8)       0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 125, 125, 16)      1168
_________________________________________________________________
max_pooling2d_4 (MaxPooling2 (None, 62, 62, 16)        0
_________________________________________________________________
dropout_6 (Dropout)          (None, 62, 62, 16)        0
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 60, 60, 32)        4640
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (None, 30, 30, 32)        0
_________________________________________________________________
dropout_7 (Dropout)          (None, 30, 30, 32)        0
_________________________________________________________________
flatten_1 (Flatten)          (None, 28800)             0
_________________________________________________________________
dense_3 (Dense)              (None, 1024)              29492224
_________________________________________________________________
dropout_8 (Dropout)          (None, 1024)              0
_________________________________________________________________
dense_4 (Dense)              (None, 256)               262400
_________________________________________________________________
dropout_9 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_5 (Dense)              (None, 2)                 514
=================================================================
Total params: 29,761,170
Trainable params: 29,761,170
Non-trainable params: 0
_________________________________________________________________
```

In [ ]:

```
model.compile(loss = 'binary_crossentropy',
              optimizer = 'adam',
              metrics = ['accuracy'])
```

In [ ]:

```
data['mask']=data['mask'].apply(lambda a :str(a))
```

In [ ]:

```
from sklearn.model_selection import train_test_split
train,test=train_test_split(data,test_size=0.15)
#dividing into train test validation
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
datagen=ImageDataGenerator(rescale=1./255.,validation_split=0.15)
#validation split is of 0.15% of train split
traingen=datagen.flow_from_dataframe(train,
              directory='/content/gdrive/MyDrive/1.3 Healthcare AI Datasets.zip (Unzipped
Files)/Healthcare AI Datasets/Brain_MRI/',
              batch_size=20,class_mode='categorical',subset='training',
              shuffle=True,target_size=(256,256),x_col='image_path',y_col='mask')
#validation ->0.15 of train
validation=datagen.flow_from_dataframe(train,
    batch_size=20,x_col='image_path',
    y_col='mask',target_size=(256,256),
    subset='validation',class_mode='categorical',shuffle=True,
    directory='/content/gdrive/MyDrive/1.3 Healthcare AI Datasets.zip (Unzipped Files)/He
althcare AI Datasets/Brain_MRI/'
)
```

```
Found 2839 validated image filenames belonging to 2 classes.
Found 500 validated image filenames belonging to 2 classes.
```

In [ ]:

```

```

In [ ]:

```
history = model.fit(
    traingen,
    steps_per_epoch = len(train)//16,
    epochs = 1,
    validation_data = validation,
    validation_steps = len(test)//16)
```

```
142/208 [====================>.........] - ETA: 5:00 - loss: 0.6711 - accuracy: 0.6659WAR
NING:tensorflow:Your input ran out of data; interrupting training. Make sure that your da
taset or generator can generate at least `steps_per_epoch * epochs` batches (in this case
, 208 batches). You may need to use the repeat() function when building your dataset.
WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your
dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this ca
se, 36 batches). You may need to use the repeat() function when building your dataset.
208/208 [==============================] - 757s 4s/step - loss: 0.6376 - accuracy: 0.6821
- val_loss: 0.5466 - val_accuracy: 0.6520
```

In [ ]:

```
image=ImageDataGenerator(rescale=1./255.)
test_generator=image.flow_from_dataframe(test,
    batch_size=20,x_col='image_path',
    y_col='mask',target_size=(256,256)
  ,class_mode='categorical',shuffle=False,
    directory='/content/gdrive/MyDrive/1.3 Healthcare AI Datasets.zip (Unzipped Files)/He
althcare AI Datasets/Brain_MRI/'
)
```

```
Found 590 validated image filenames belonging to 2 classes.
```

In [ ]:

```
model.save_weights('tumor.h5')
print('Training accuracy: {:.3f}'.format(history.history['accuracy'][-1]))
```

```
Training accuracy: 0.717
```

In [ ]:

```
predicted = model.predict(test_generator)

predicted=np.array([str(np.argmax(i))for i in predicted])
predicted
```

Out[ ]:

```
array(['0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '0', '0', '0',
```

```
       '0', '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '1', '0', '0', '0', '1', '0', '0', '0', '0', '0',
       '0', '1', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '1', '0', '0', '1', '0', '0', '0', '0', '0',
       '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '1', '0', '0', '0', '1', '0', '1', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '1',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '1', '0', '0', '0', '0', '0', '0', '1', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '1',
       '1', '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '1', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '1', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '1', '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '0', '0',
       '1', '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '1', '0', '1', '0', '0', '0', '0', '0',
       '1', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '1',
       '0', '0', '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0'], dtype='<U1')
```

In [ ]:

```
predicted.shape
```

Out[ ]:

```
(590, 2)
```

In [ ]:

```
real=np.array(test['mask'])
real
```

Out[ ]:

```
array(['1', '0', '1', '0', '0', '1', '0', '0', '1', '1', '0', '1', '0',
       '0', '1', '0', '0', '0', '0', '1', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '1', '0', '1', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '0', '1',
       '1', '0', '0', '0', '1', '0', '0', '0', '1', '1', '1', '0', '0',
       '0', '0', '1', '1', '1', '0', '0', '1', '1', '0', '0', '0', '1',
       '0', '1', '1', '0', '0', '0', '0', '1', '1', '1', '0', '0', '0',
       '1', '1', '1', '0', '1', '0', '0', '0', '0', '0', '1', '0', '0',
       '1', '1', '0', '0', '0', '0', '1', '1', '1', '0', '0', '0', '0',
       '0', '0', '1', '0', '1', '0', '0', '1', '0', '0', '0', '0', '1',
       '0', '0', '1', '0', '0', '0', '0', '0', '0', '0', '0', '0', '0',
       '0', '1', '1', '1', '1', '0', '1', '1', '0', '1', '1', '0', '0',
```

```
       '0', '0', '0', '1', '0', '0', '0', '1', '0', '1', '1', '0', '1',
       '0', '1', '1', '0', '1', '0', '0', '0', '0', '1', '0', '1', '0',
       '1', '0', '0', '0', '0', '0', '0', '1', '0', '0', '0', '0', '0',
       '0', '1', '0', '1', '1', '1', '1', '0', '1', '0', '1', '1', '1',
       '1', '0', '0', '1', '1', '0', '0', '0', '1', '0', '1', '0', '0',
       '0', '1', '0', '1', '0', '1', '1', '1', '0', '1', '1', '0', '0',
       '0', '0', '1', '0', '0', '0', '0', '1', '0', '0', '1', '1', '0',
       '0', '1', '0', '0', '0', '0', '1', '0', '0', '0', '0', '0', '1',
       '1', '0', '0', '1', '0', '0', '1', '1', '1', '1', '0', '1', '0',
       '0', '0', '0', '0', '1', '0', '1', '0', '0', '1', '0', '1', '1',
       '1', '1', '1', '0', '0', '1', '0', '0', '1', '1', '0', '1', '1',
       '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '1', '1', '0',
       '1', '0', '1', '0', '1', '0', '0', '0', '0', '0', '1', '1', '1',
       '1', '0', '0', '1', '1', '0', '1', '0', '0', '0', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '1', '0', '0', '1', '0', '1', '0',
       '0', '0', '0', '0', '0', '0', '1', '0', '0', '1', '0', '1', '0',
       '0', '1', '0', '0', '0', '0', '0', '0', '0', '0', '1', '0', '0',
       '1', '1', '1', '1', '1', '1', '0', '0', '1', '0', '0', '0', '0',
       '1', '1', '0', '0', '0', '0', '0', '1', '0', '0', '0', '0', '1',
       '1', '0', '0', '1', '0', '0', '1', '0', '1', '1', '1', '0', '1',
       '1', '0', '0', '0', '1', '0', '0', '0', '1', '0', '0', '1', '0',
       '1', '1', '0', '0', '1', '0', '0', '0', '1', '0', '0', '0', '0',
       '0', '1', '0', '0', '0', '1', '0', '1', '0', '0', '0', '1', '0',
       '0', '0', '0', '1', '1', '1', '0', '1', '0', '1', '0', '1', '0',
       '1', '1', '1', '0', '0', '1', '1', '0', '0', '0', '0', '1', '0',
       '1', '1', '0', '1', '0', '1', '1', '0', '1', '0', '0', '1', '0',
       '0', '1', '0', '0', '0', '0', '0', '0', '1', '1', '1', '0', '0',
       '1', '0', '0', '0', '1', '0', '0', '0', '0', '1', '0', '0', '0',
       '1', '0', '1', '0', '0', '1', '1', '1', '0', '0', '1', '1', '0',
       '1', '0', '0', '1', '1', '0', '0', '0', '1', '1', '0', '0', '1',
       '1', '0', '0', '0', '0', '1', '0', '1', '1', '1', '0', '0', '0',
       '0', '0', '0', '0', '0', '0', '1', '1', '0', '0', '1', '0', '1',
       '1', '0', '0', '1', '1', '0', '0', '0', '0', '0', '1', '0', '0',
       '0', '0', '0', '0', '0'], dtype=object)
```

In [ ]:

```
from sklearn.metrics import classification_report,accuracy_score,confusion_matrix
print(classification_report(real,predicted))
```

```
              precision    recall  f1-score   support

           0       0.67      0.98      0.80       376
           1       0.85      0.15      0.26       214

    accuracy                           0.68       590
   macro avg       0.76      0.57      0.53       590
weighted avg       0.73      0.68      0.60       590
```