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

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

```
from numpy import mean
from numpy import std
from matplotlib import pyplot
from sklearn.model_selection import KFold
from keras.datasets import mnist
from keras.utils import to_categorical
from keras.models import Sequential
from keras.layers import Conv2D
from keras.layers import MaxPooling2D
from keras.layers import Dense
from keras.layers import Flatten
from keras.optimizers import SGD
from keras.layers import Dropout
from keras.layers import BatchNormalization
import keras
from keras import backend as K
import matplotlib.pyplot as plt
import sklearn
```

```
path_normal = '/content/drive/MyDrive/Deep learning demo project/Normal/'
path_pneumonia = '/content/drive/MyDrive/Deep learning demo project/pneumonia/'
```

```
##Import necessary libraries
import numpy as np
import PIL
import cv2
import os
data1 = list()
data2 = list()
x = list()
```

```
##Class-1 images##

for image in os.walk(path_normal):
  data1.append(image[2])

for i in range(len(data1[0])):
  str_complete = path_normal + data1[0][i]
  img = cv2.imread(str_complete)
  img = cv2.resize(img, (224, 224))
  x.append(img)
  print(i)#Ensure all images are loaded
```

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```

```
print(img.shape)
```

```
(224, 224, 3)
```

```
##Class-2 images##

for image in os.walk(path_pneumonia):
  data2.append(image[2])

for i in range(len(data2[0])):
  str_complete = path_pneumonia + data2[0][i]
  img = cv2.imread(str_complete)
  img = cv2.resize(img, (224, 224))
  x.append(img)#Ensure all images are loaded
  print(i)
```

```
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```

```
data_x = np.asarray(x)
```

```
data_x.shape
```

```
(1400, 224, 224, 3)
```

```
x=data_x
```

```
y = np.zeros(1400)
y[:700] =1
y[700:1400]=2
```

```
from sklearn.model_selection import train_test_split
```

```
##Dataset Split##
from sklearn.model_selection import train_test_split
from keras.utils import to_categorical
#y = to_categorical(y)
x_train, x_test, y_train, y_test = train_test_split(data_x, y, test_size=0.2, random_state=1)
x_train, x_val, y_train, y_val = train_test_split(x_train, y_train, test_size=1/8, random_state=1)

y_tr_one_hot  = np.zeros((np.array(y_train).shape[0],2))

for i in range(np.array(y_train).shape[0]):
  label = y_train[i]-1
  y_tr_one_hot[i][int(label)] = 1
```

```
y_val_one_hot  = np.zeros((np.array(y_val).shape[0],2))

for i in range(np.array(y_val).shape[0]):
  label = y_val[i]-1
  y_val_one_hot[i][int(label)] = 1
```

```
y_te_one_hot  = np.zeros((np.array(y_test).shape[0],2))

for i in range(np.array(y_test).shape[0]):
  label = y_test[i]-1
  y_te_one_hot[i][int(label)] = 1
```

```
from keras.models import load_model
from keras.layers import Lambda
import tensorflow as tf
from tensorflow.keras.models import Model
from tensorflow.keras.layers import GlobalAveragePooling2D, Dense
```

```
model = tf.keras.applications.EfficientNetV2S(include_top=False,input_shape=(224,224,3))
# mark loaded layers as not trainable
for layer in model.layers:
  layer.trainable = False
# add new classifier layers
flat1 = Flatten()(model.layers[-1].output)
#x=Dense(1024,activation='relu')(flat1) # FC layer 1
#x=Dense(64,activation='relu')(x)   # FC layer 2
output = Dense(2, activation='softmax')(flat1)
model = Model(inputs=model.inputs, outputs=output)

optimizer = tf.keras.optimizers.Adam(learning_rate=0.01)
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
model.fit(x_train, y_tr_one_hot, validation_data=(x_val, y_val_one_hot), epochs=5, batch_size=200,verbose=1)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/efficientnet_v2/efficientnetv2-s_notop
82420632/82420632 [==============================] - 4s 0us/step
Epoch 1/5
5/5 [==============================] - 293s 56s/step - loss: 0.1846 - accuracy: 0.8969 - val_loss: 0.1529 - val_accuracy:
```

```
Epoch 2/5
5/5 [==============================] - 259s 54s/step - loss: 0.0193 - accuracy: 0.9939 - val_loss: 0.0825 - val_accuracy:
Epoch 3/5
5/5 [==============================] - 262s 54s/step - loss: 7.9801e-04 - accuracy: 0.9990 - val_loss: 0.0059 - val_accu
Epoch 4/5
5/5 [==============================] - 257s 53s/step - loss: 4.3612e-05 - accuracy: 1.0000 - val_loss: 0.0432 - val_accu
Epoch 5/5
5/5 [==============================] - 261s 54s/step - loss: 1.1590e-06 - accuracy: 1.0000 - val_loss: 0.0690 - val_accu
<keras.callbacks.History at 0x7f057d98cdf0>
```

```
import sklearn
from sklearn.metrics import confusion_matrix


test_loss, test_acc = model.evaluate(np.array(x_test), np.array(y_te_one_hot), verbose=0)
print(test_acc)
##Evaluating Sensitivity, Accuracy and Kappa scores
y_prob = model.predict(x_test)
Y_pred = y_prob.argmax(axis=-1)
```

```
0.9964285492897034
9/9 [==============================] - 57s 6s/step
```

```
cm1 = confusion_matrix(y_test-1,Y_pred)
print("confusion matrix \n",cm1)
```

```
confusion matrix
 [[137   0]
 [  1 142]]
```

```
from sklearn.metrics import classification_report


import pandas as pd


print(pd.DataFrame(classification_report(y_test-1,Y_pred,output_dict=True)).T)
Kappa=sklearn.metrics.cohen_kappa_score(y_test-1,Y_pred)
print('Kappa=',Kappa)
```

```
                precision    recall  f1-score     support
0.0              0.992754  1.000000  0.996364  137.000000
1.0              1.000000  0.993007  0.996491  143.000000
accuracy         0.996429  0.996429  0.996429    0.996429
macro avg        0.996377  0.996503  0.996427  280.000000
weighted avg     0.996454  0.996429  0.996429  280.000000
Kappa= 0.9928549555986527
```

✓ 0s completed at 11:45