



```
In [1]: !pip install gradio
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: gradio in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (3.15.0)
Requirement already satisfied: pydub in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (0.25.1)
Requirement already satisfied: jinja2 in c:\programdata\anaconda3\lib\site-packages (from gradio) (2.11.3)
Requirement already satisfied: markupsafe in c:\programdata\anaconda3\lib\site-packages (from gradio) (2.0.1)
Requirement already satisfied: requests in c:\programdata\anaconda3\lib\site-packages (from gradio) (2.27.1)
Requirement already satisfied: altair>=4.2.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (4.2.0)
Requirement already satisfied: pillow in c:\programdata\anaconda3\lib\site-packages (from gradio) (9.0.1)
Requirement already satisfied: matplotlib in c:\programdata\anaconda3\lib\site-packages (from gradio) (3.5.1)
Requirement already satisfied: fsspec in c:\programdata\anaconda3\lib\site-packages (from gradio) (2022.2.0)
Requirement already satisfied: aiohttp in c:\programdata\anaconda3\lib\site-packages (from gradio) (3.8.1)
Requirement already satisfied: ffmpeg in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (0.3.0)
Requirement already satisfied: uvicorn in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (0.20.0)
Requirement already satisfied: python-multipart in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (0.0.5)
Requirement already satisfied: httpx in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (0.23.2)
Requirement already satisfied: numpy in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (1.20.0)
Requirement already satisfied: websockets>=10.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (10.4)
Requirement already satisfied: pyyaml in c:\programdata\anaconda3\lib\site-packages (from gradio) (6.0)
Requirement already satisfied: pandas in c:\programdata\anaconda3\lib\site-packages (from gradio) (1.4.2)
Requirement already satisfied: fastapi in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (0.88.0)
Requirement already satisfied: orjson in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (3.8.3)
Requirement already satisfied: pydantic in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (1.10.4)
Requirement already satisfied: pycryptodome in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (3.16.0)
Requirement already satisfied: markdown-it-py[linkify,plugins] in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from gradio) (2.1.0)
Requirement already satisfied: toolz in c:\programdata\anaconda3\lib\site-packages (from altair>=4.2.0->gradio) (0.11.2)
Requirement already satisfied: jsonschema>=3.0 in c:\programdata\anaconda3\lib\site-packages (from altair>=4.2.0->gradio) (4.4.0)
Requirement already satisfied: entrypoints in c:\programdata\anaconda3\lib\site-packages (from altair>=4.2.0->gradio) (0.4)
Requirement already satisfied: attrs>=17.4.0 in c:\programdata\anaconda3\lib\site-packages (from jsonschema>=3.0->altair>=4.2.0->gradio) (21.4.0)
Requirement already satisfied: pyrsistent!=0.17.0,!0.17.1,!0.17.2,>0.14.0
```

```
in c:\programdata\anaconda3\lib\site-packages (from jsonschema>=3.0->altair>=4.2.0->radio) (0.18.0)
Requirement already satisfied: pytz>=2020.1 in c:\programdata\anaconda3\lib\site-packages (from pandas->radio) (2021.3)
Requirement already satisfied: python-dateutil>=2.8.1 in c:\programdata\anaconda3\lib\site-packages (from pandas->radio) (2.8.2)
Requirement already satisfied: six>=1.5 in c:\programdata\anaconda3\lib\site-packages (from python-dateutil>=2.8.1->pandas->radio) (1.16.0)
Requirement already satisfied: aiosignal>=1.1.2 in c:\programdata\anaconda3\lib\site-packages (from aiohttp->radio) (1.2.0)
Requirement already satisfied: charset-normalizer<3.0,>=2.0 in c:\programdata\anaconda3\lib\site-packages (from aiohttp->radio) (2.0.4)
Requirement already satisfied: frozenlist>=1.1.1 in c:\programdata\anaconda3\lib\site-packages (from aiohttp->radio) (1.2.0)
Requirement already satisfied: yarl<2.0,>=1.0 in c:\programdata\anaconda3\lib\site-packages (from aiohttp->radio) (1.6.3)
Requirement already satisfied: async-timeout<5.0,>=4.0.0a3 in c:\programdata\anaconda3\lib\site-packages (from aiohttp->radio) (4.0.1)
Requirement already satisfied: multidict<7.0,>=4.5 in c:\programdata\anaconda3\lib\site-packages (from aiohttp->radio) (5.1.0)
Requirement already satisfied: typing-extensions>=3.6.5 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from async-timeout<5.0,>=4.0.0a3->aiohttp->radio) (4.4.0)
Requirement already satisfied: idna>=2.0 in c:\programdata\anaconda3\lib\site-packages (from yarl<2.0,>=1.0->aiohttp->radio) (3.3)
Requirement already satisfied: starlette==0.22.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from fastapi->radio) (0.22.0)
Requirement already satisfied: anyio<5,>=3.4.0 in c:\programdata\anaconda3\lib\site-packages (from starlette==0.22.0->fastapi->radio) (3.5.0)
Requirement already satisfied: sniffio>=1.1 in c:\programdata\anaconda3\lib\site-packages (from anyio<5,>=3.4.0->starlette==0.22.0->fastapi->radio) (1.2.0)
Requirement already satisfied: rfc3986[idna2008]<2,>=1.3 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from httpx->radio) (1.5.0)
Requirement already satisfied: httpcore<0.17.0,>=0.15.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from httpx->radio) (0.16.3)
Requirement already satisfied: certifi in c:\programdata\anaconda3\lib\site-packages (from httpx->radio) (2021.10.8)
Requirement already satisfied: h11<0.15,>=0.13 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from httpcore<0.17.0,>=0.15.0->httpx->radio) (0.14.0)
Requirement already satisfied: mdurl~=0.1 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from markdown-it-py[linkify,plugins]->radio) (0.1.2)
Requirement already satisfied: linkify-it-py~=1.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from markdown-it-py[linkify,plugins]->radio) (1.0.3)
Requirement already satisfied: mdit-py-plugins in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from markdown-it-py[linkify,plugins]->radio) (0.3.3)
Requirement already satisfied: uc-micro-py in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from linkify-it-py~=1.0->markdown-it-py[linkify,plugins]->radio) (1.0.1)
Requirement already satisfied: pyparsing>=2.2.1 in c:\programdata\anaconda3\lib\site-packages (from matplotlib->radio) (3.0.4)
```

```
Requirement already satisfied: kiwisolver>=1.0.1 in c:\programdata\anaconda3\lib\site-packages (from matplotlib->gradio) (1.3.2)
Requirement already satisfied: packaging>=20.0 in c:\programdata\anaconda3\lib\site-packages (from matplotlib->gradio) (21.3)
Requirement already satisfied: cycler>=0.10 in c:\programdata\anaconda3\lib\site-packages (from matplotlib->gradio) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\programdata\anaconda3\lib\site-packages (from matplotlib->gradio) (4.25.0)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\programdata\anaconda3\lib\site-packages (from requests->gradio) (1.26.9)
Requirement already satisfied: click>=7.0 in c:\programdata\anaconda3\lib\site-packages (from uvicorn->gradio) (8.0.4)
Requirement already satisfied: colorama in c:\programdata\anaconda3\lib\site-packages (from click>=7.0->uvicorn->gradio) (0.4.4)
```

## Importing the necessary libraries

```
In [2]: pip install tensorflow
```

```
Defaulting to user installation because normal site-packages is not writeable
Note: you may need to restart the kernel to use updated packages.
Requirement already satisfied: tensorflow in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (2.11.0)
Requirement already satisfied: tensorflow-intel==2.11.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow) (2.11.0)
Requirement already satisfied: typing-extensions>=3.6.6 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (4.4.0)
Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (3.3.0)
Requirement already satisfied: keras<2.12,>=2.11.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.11.0)
Requirement already satisfied: packaging in c:\programdata\anaconda3\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (21.3)
Requirement already satisfied: six>=1.12.0 in c:\programdata\anaconda3\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.16.0)
Requirement already satisfied: numpy>=1.20 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.20.0)
Requirement already satisfied: libclang>=13.0.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (14.0.6)
Requirement already satisfied: tensorflow-estimator<2.12,>=2.11.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.11.0)
Requirement already satisfied: astunparse>=1.6.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.6.3)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (0.29.0)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (0.4.0)
Requirement already satisfied: protobuf<3.20,>=3.9.2 in c:\programdata\anaconda3\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (3.19.1)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\programdata\anaconda3\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.42.0)
Requirement already satisfied: flatbuffers>=2.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (23.1.4)
Requirement already satisfied: h5py>=2.9.0 in c:\programdata\anaconda3\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (3.6.0)
Requirement already satisfied: tensorboard<2.12,>=2.11 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.11.0)
Requirement already satisfied: wrapt>=1.11.0 in c:\programdata\anaconda3\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.12.1)
Requirement already satisfied: google-pasta>=0.1.1 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (0.2.0)
Requirement already satisfied: setuptools in c:\programdata\anaconda3\lib\site-packages (from tensorflow-intel==2.11.0->tensorflow) (61.2.0)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\p.vijay kumar\app
```

```
data\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (2.2.0)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorflow-intel==2.11.0->tensorflow) (1.3.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\programdata\anaconda3\lib\site-packages (from astunparse>=1.6.0->tensorflow-intel==2.11.0->tensorflow) (0.37.1)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\programdata\anaconda3\lib\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (1.33.0)
Requirement already satisfied: werkzeug>=1.0.1 in c:\programdata\anaconda3\lib\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.0.3)
Requirement already satisfied: markdown>=2.6.8 in c:\programdata\anaconda3\lib\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (3.3.4)
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.4.6)
Requirement already satisfied: requests<3,>=2.21.0 in c:\programdata\anaconda3\lib\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.27.1)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (1.8.1)
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.6.1)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\programdata\anaconda3\lib\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (4.7.2)
Requirement already satisfied: cachetools<5.0,>=2.0.0 in c:\programdata\anaconda3\lib\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (4.2.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\programdata\anaconda3\lib\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.2.8)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (1.3.1)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\programdata\anaconda3\lib\site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (0.4.8)
Requirement already satisfied: certifi>=2017.4.17 in c:\programdata\anaconda3\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2021.10.8)
Requirement already satisfied: charset-normalizer~2.0.0 in c:\programdata\anaconda3\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\programdata\anaconda3\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (3.3)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\programdata\anaconda3\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.12,>=2.11->tensorflow-intel==2.11.0->tensorflow) (1.26.9)
```

```
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<0.5,>=0.4.1->tensorboard<2.12,>=2.11->tensorflow-intel==2.1.0->tensorflow) (3.2.2)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in c:\programdata\anaconda3\lib\site-packages (from packaging->tensorflow-intel==2.11.0->tensorflow) (3.0.4)
```

In [3]: `pip install opencv-python or conda install opencv-python`

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: opencv-python in c:\users\p.vijay kumar\appdata\roaming\python\python39\site-packages (4.8.0.76)
Note: you may need to restart the kernel to use updated packages.
```

```
WARNING: Retrying (Retry(total=4, connect=None, read=None, redirect=None, status=None)) after connection broken by 'NewConnectionError('<pip._vendor.urllib3.connection.HTTPSConnection object at 0x000001394BBE0D60>: Failed to establish a new connection: [Errno 11001] getaddrinfo failed')': /simple/or/
WARNING: Retrying (Retry(total=3, connect=None, read=None, redirect=None, status=None)) after connection broken by 'ProtocolError('Connection aborted.', ConnectionResetError(10054, 'An existing connection was forcibly closed by the remote host', None, 10054, None))': /simple/or/
WARNING: Retrying (Retry(total=2, connect=None, read=None, redirect=None, status=None)) after connection broken by 'ReadTimeoutError("HTTPSConnectionPool (host='pypi.org', port=443): Read timed out. (read timeout=15)": /simple/or/
ERROR: Could not find a version that satisfies the requirement or (from versions: none)
ERROR: No matching distribution found for or
```

In [4]: `import matplotlib.pyplot as plt
import seaborn as sns
import keras
from keras.models import Sequential
from keras.layers import Dense, Conv2D, MaxPool2D, Flatten, Dropout, BatchNormalization
from keras.preprocessing.image import ImageDataGenerator
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report, confusion_matrix
from keras.callbacks import ReduceLROnPlateau
import cv2
import os
import numpy as np
import pandas as pd
import gradio`

```
In [5]: labels = ['PNEUMONIA', 'NORMAL']
img_size = 150
def get_training_data(data_dir):
    data = []
    for label in labels:
        path = os.path.join(data_dir, label)
        class_num = labels.index(label)
        for img in os.listdir(path):
            try:
                img_arr = cv2.imread(os.path.join(path, img), cv2.IMREAD_GRAYSCALE)
                resized_arr = cv2.resize(img_arr, (img_size, img_size)) # Reshaping
                data.append([resized_arr, class_num])
            except Exception as e:
                print(e)
    return np.array(data)
```

## Loading the Dataset

```
In [6]: train = get_training_data(r'C:\Users\P.Vijay Kumar\OneDrive\Desktop\train')
test = get_training_data(r'C:\Users\P.Vijay Kumar\OneDrive\Desktop\test')
val = get_training_data(r'C:\Users\P.Vijay Kumar\OneDrive\Desktop\val')
```

C:\Users\P.Vijay Kumar\AppData\Local\Temp\ipykernel\_17264\771166761.py:15: VisibleDeprecationWarning: Creating an ndarray from ragged nested sequences (which is a list-or-tuple of lists-or-tuples-or ndarrays with different lengths or shapes) is deprecated. If you meant to do this, you must specify 'dtype=object' when creating the ndarray.

```
return np.array(data)
```

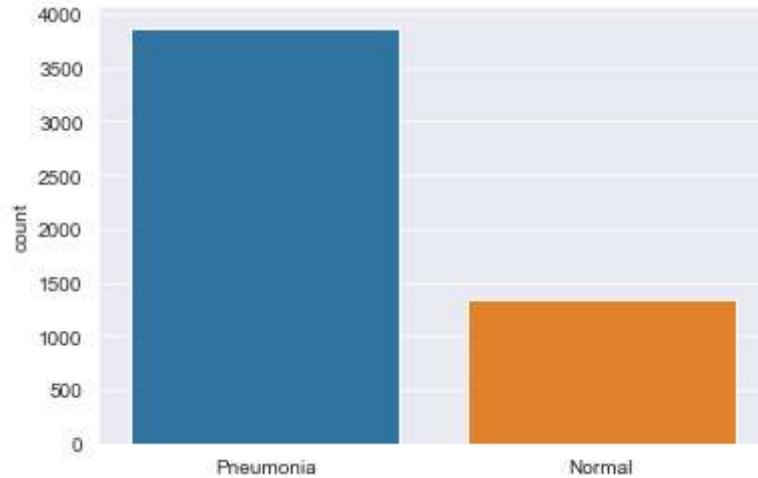
## Data Visualization & Preprocessing

```
In [7]: l = []
for i in train:
    if(i[1] == 0):
        l.append("Pneumonia")
    else:
        l.append("Normal")
sns.set_style('darkgrid')
sns.countplot(l)
```

C:\ProgramData\Anaconda3\lib\site-packages\seaborn\\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

```
warnings.warn(
```

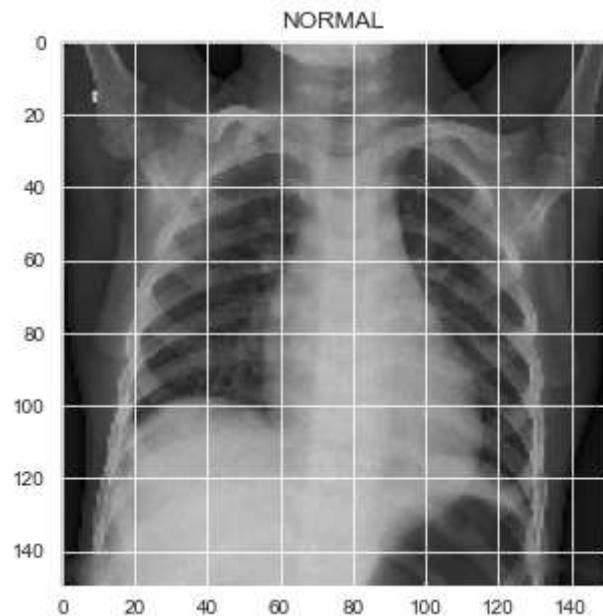
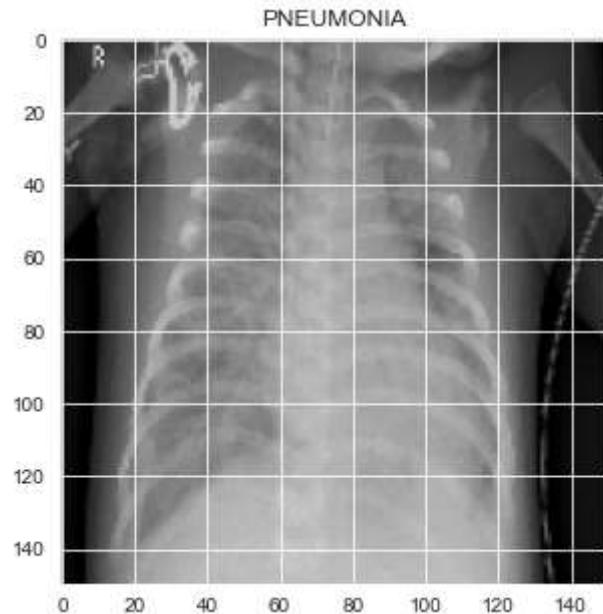
Out[7]: <AxesSubplot:ylabel='count'>



```
In [8]: plt.figure(figsize = (5,5))
plt.imshow(train[0][0], cmap='gray')
plt.title(labels[train[0][1]])

plt.figure(figsize = (5,5))
plt.imshow(train[-1][0], cmap='gray')
plt.title(labels[train[-1][1]])
```

Out[8]: Text(0.5, 1.0, 'NORMAL')



```
In [9]: x_train = []
y_train = []

x_val = []
y_val = []

x_test = []
y_test = []

for feature, label in train:
    x_train.append(feature)
    y_train.append(label)

for feature, label in test:
    x_test.append(feature)
    y_test.append(label)

for feature, label in val:
    x_val.append(feature)
    y_val.append(label)
```

```
In [10]: # Normalize the data
x_train = np.array(x_train) / 255
x_val = np.array(x_val) / 255
x_test = np.array(x_test) / 255
```

```
In [11]: # resize data for deep Learning
x_train = x_train.reshape(-1, img_size, img_size, 1)
y_train = np.array(y_train)

x_val = x_val.reshape(-1, img_size, img_size, 1)
y_val = np.array(y_val)

x_test = x_test.reshape(-1, img_size, img_size, 1)
y_test = np.array(y_test)
```

## Data Augmentation

```
In [12]: # With data augmentation to prevent overfitting and handling the imbalance in data

datagen = ImageDataGenerator(
    featurewise_center=False, # set input mean to 0 over the dataset
    samplewise_center=False, # set each sample mean to 0
    featurewise_std_normalization=False, # divide inputs by std of the dataset
    samplewise_std_normalization=False, # divide each input by its std
    zca_whitening=False, # apply ZCA whitening
    rotation_range = 30, # randomly rotate images in the range (degrees, 0 to 180)
    zoom_range = 0.2, # Randomly zoom image
    width_shift_range=0.1, # randomly shift images horizontally (fraction of total width)
    height_shift_range=0.1, # randomly shift images vertically (fraction of total height)
    horizontal_flip = True, # randomly flip images
    vertical_flip=False) # randomly flip images

datagen.fit(x_train)
```

## Training the Model

```
In [13]: model = Sequential()
model.add(Conv2D(32 , (3,3) , strides = 1 , padding = 'same' , activation = 'relu'))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2) , strides = 2 , padding = 'same'))
model.add(Conv2D(64 , (3,3) , strides = 1 , padding = 'same' , activation = 'relu'))
model.add(Dropout(0.1))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2) , strides = 2 , padding = 'same'))
model.add(Conv2D(64 , (3,3) , strides = 1 , padding = 'same' , activation = 'relu'))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2) , strides = 2 , padding = 'same'))
model.add(Conv2D(128 , (3,3) , strides = 1 , padding = 'same' , activation = 'relu'))
model.add(Dropout(0.2))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2) , strides = 2 , padding = 'same'))
model.add(Conv2D(256 , (3,3) , strides = 1 , padding = 'same' , activation = 'relu'))
model.add(Dropout(0.2))
model.add(BatchNormalization())
model.add(MaxPool2D((2,2) , strides = 2 , padding = 'same'))
model.add(Flatten())
model.add(Dense(units = 128 , activation = 'relu'))
model.add(Dropout(0.2))
model.add(Dense(units = 1 , activation = 'sigmoid'))
model.compile(optimizer = "rmsprop" , loss = 'binary_crossentropy' , metrics = ['accuracy'])
model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 150, 150, 32)	320
batch_normalization (BatchNormalization)	(None, 150, 150, 32)	128
max_pooling2d (MaxPooling2D)	(None, 75, 75, 32)	0
conv2d_1 (Conv2D)	(None, 75, 75, 64)	18496
dropout (Dropout)	(None, 75, 75, 64)	0
batch_normalization_1 (BatchNormalization)	(None, 75, 75, 64)	256
max_pooling2d_1 (MaxPooling2D)	(None, 38, 38, 64)	0
conv2d_2 (Conv2D)	(None, 38, 38, 64)	36928
batch_normalization_2 (BatchNormalization)	(None, 38, 38, 64)	256
max_pooling2d_2 (MaxPooling2D)	(None, 19, 19, 64)	0
conv2d_3 (Conv2D)	(None, 19, 19, 128)	73856
dropout_1 (Dropout)	(None, 19, 19, 128)	0
batch_normalization_3 (BatchNormalization)	(None, 19, 19, 128)	512
max_pooling2d_3 (MaxPooling2D)	(None, 10, 10, 128)	0
conv2d_4 (Conv2D)	(None, 10, 10, 256)	295168
dropout_2 (Dropout)	(None, 10, 10, 256)	0
batch_normalization_4 (BatchNormalization)	(None, 10, 10, 256)	1024
max_pooling2d_4 (MaxPooling2D)	(None, 5, 5, 256)	0
flatten (Flatten)	(None, 6400)	0
dense (Dense)	(None, 128)	819328
dropout_3 (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 1)	129

```
=====
Total params: 1,246,401
Trainable params: 1,245,313
Non-trainable params: 1,088
```

```
In [14]: learning_rate_reduction = ReduceLROnPlateau(monitor='val_accuracy', patience =
```

```
In [ ]: history = model.fit(datagen.flow(x_train,y_train, batch_size = 32) ,epochs = 12)
```

```
Epoch 1/12
163/163 [=====] - 183s 1s/step - loss: 0.5773 - accuracy: 0.8344 - val_loss: 24.2200 - val_accuracy: 0.5000 - lr: 0.0010
Epoch 2/12
24/163 [==>.....] - ETA: 3:05 - loss: 0.3615 - accuracy: 0.8594
```

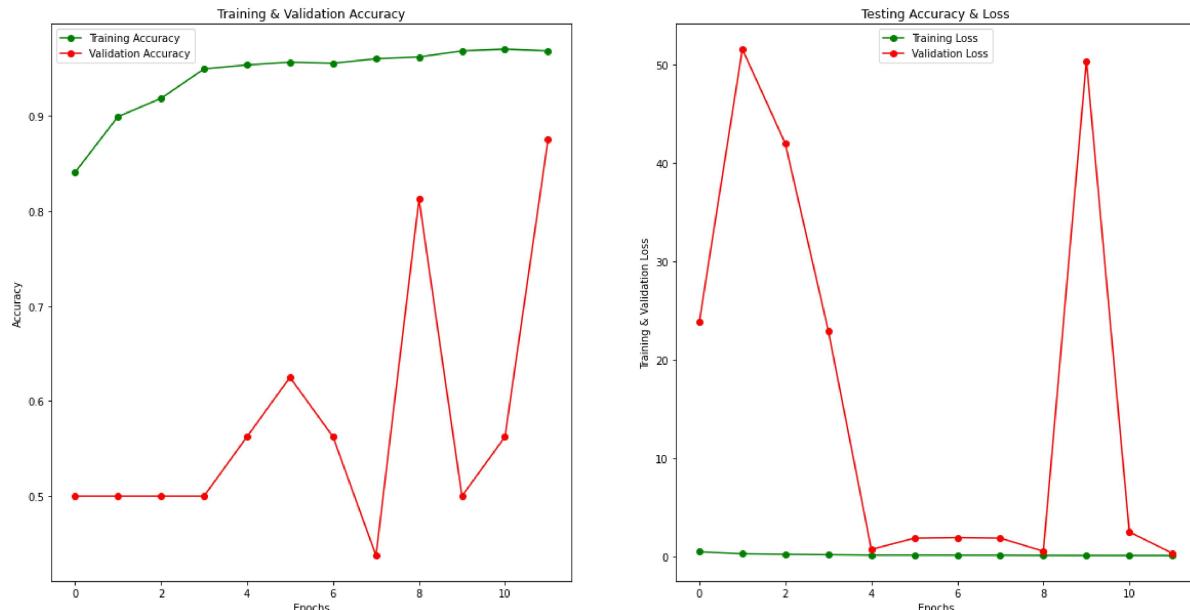
```
In [19]: print("Loss of the model is - " , model.evaluate(x_test,y_test)[0])
print("Accuracy of the model is - " , model.evaluate(x_test,y_test)[1]*100 , "%")
20/20 [=====] - 6s 277ms/step - loss: 0.3845 - accuracy: 0.8317
Loss of the model is - 0.38449472188949585
20/20 [=====] - 6s 286ms/step - loss: 0.3845 - accuracy: 0.8317
Accuracy of the model is - 83.17307829856873 %
```

## Analysis after Model Training

```
In [20]: epochs = [i for i in range(12)]
fig , ax = plt.subplots(1,2)
train_acc = history.history[ 'accuracy' ]
train_loss = history.history[ 'loss' ]
val_acc = history.history[ 'val_accuracy' ]
val_loss = history.history[ 'val_loss' ]
fig.set_size_inches(20,10)

ax[0].plot(epochs , train_acc , 'go-' , label = 'Training Accuracy')
ax[0].plot(epochs , val_acc , 'ro-' , label = 'Validation Accuracy')
ax[0].set_title('Training & Validation Accuracy')
ax[0].legend()
ax[0].set_xlabel("Epochs")
ax[0].set_ylabel("Accuracy")

ax[1].plot(epochs , train_loss , 'g-o' , label = 'Training Loss')
ax[1].plot(epochs , val_loss , 'r-o' , label = 'Validation Loss')
ax[1].set_title('Testing Accuracy & Loss')
ax[1].legend()
ax[1].set_xlabel("Epochs")
ax[1].set_ylabel("Training & Validation Loss")
plt.show()
```



```
In [21]: predictions = model.predict(x_test)
for i in range(len(predictions)):
    predictions[i] = 1 if predictions[i]>0.5 else 0
```

20/20 [=====] - 7s 288ms/step

```
In [22]: print(classification_report(y_test, predictions, target_names = ['Pneumonia (C0)', 'Normal (C1)']))
```

	precision	recall	f1-score	support
Pneumonia (Class 0)	0.96	0.76	0.85	390
Normal (Class 1)	0.70	0.95	0.81	234
accuracy			0.83	624
macro avg	0.83	0.86	0.83	624
weighted avg	0.87	0.83	0.83	624

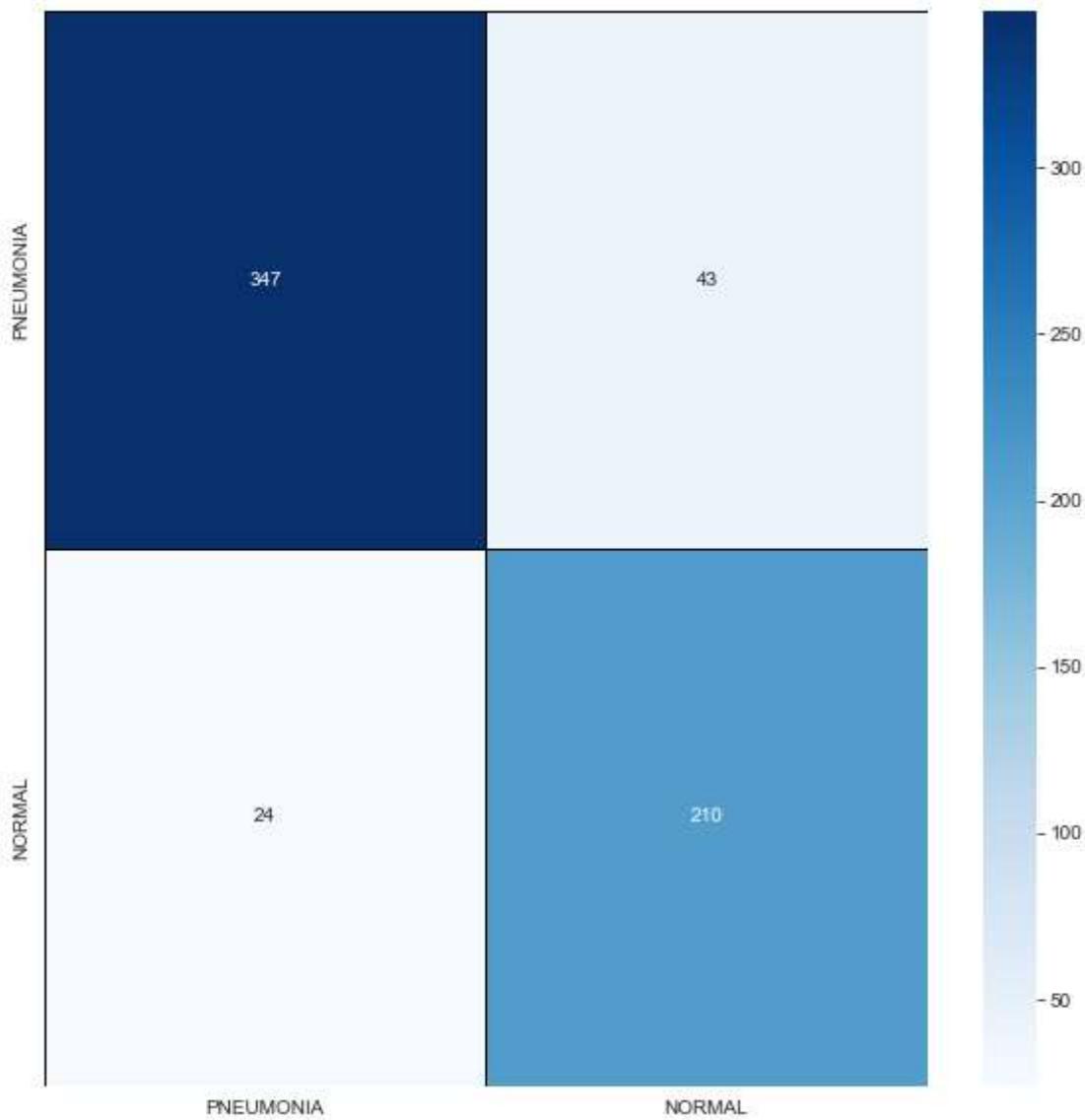
```
In [23]: cm = confusion_matrix(y_test,predictions)  
cm
```

```
Out[23]: array([[297,  93],  
                 [ 12, 222]], dtype=int64)
```

```
In [24]: cm = pd.DataFrame(cm , index = ['0','1'] , columns = ['0','1'])
```

```
In [22]: plt.figure(figsize = (10,10))
sns.heatmap(cm, cmap= "Blues", linecolor = 'black' , linewidth = 1 , annot = True)
```

```
Out[22]: <AxesSubplot:>
```



```
In [26]: def Pneumonia(img):
    img = np.array(img)/255
    img = img.reshape(-1, 150, 150, 1)
    isARDS = model.predict(img)[0]
    imgClass = "Normal" if isARDS<0.5 else "Pneumonia"
    return imgClass
```

```
In [27]: pr = model.predict(x_test)
for i in range(len(pr)):
    if pr[i]>0.5:
        pr[i]=1
    else:
        pr[i]=0
```

```
20/20 [=====] - 6s 285ms/step
```

```
In [28]: img = gradio.inputs.Image(shape=(150, 150))
label = gradio.outputs.Label(num_top_classes=1)
```

```
C:\Users\P.Vijay Kumar\AppData\Roaming\Python\Python39\site-packages\gradio\i
nputs.py:256: UserWarning: Usage of gradio.inputs is deprecated, and will not
be supported in the future, please import your component from gradio.componen
ts
    warnings.warn(
C:\Users\P.Vijay Kumar\AppData\Roaming\Python\Python39\site-packages\gradio\d
eprecation.py:40: UserWarning: `optional` parameter is deprecated, and it has
no effect
    warnings.warn(value)
C:\Users\P.Vijay Kumar\AppData\Roaming\Python\Python39\site-packages\gradio\o
utputs.py:196: UserWarning: Usage of gradio.outputs is deprecated, and will n
ot be supported in the future, please import your components from gradio.comp
onents
    warnings.warn(
C:\Users\P.Vijay Kumar\AppData\Roaming\Python\Python39\site-packages\gradio\d
eprecation.py:40: UserWarning: The 'type' parameter has been deprecated. Use
the Number component instead.
    warnings.warn(value)
```

```
In [29]: interface = gradio.Interface(fn = Pneumonia,
                                    title = "Pneumonia Detection using Chest X-Ray",
                                    inputs = img,
                                    outputs = label,
                                    interpretation = "default")
interface.launch(debug=True, share=True)
```

Running on local URL: <http://127.0.0.1:7860> (<http://127.0.0.1:7860>)

1/1 [=====] - 0s 115ms/step

Running on public URL: <https://3ebbbe6-a37e-45a2.gradio.live> (<https://3ebbbe6-a37e-45a2.gradio.live>)

This share link expires in 72 hours. For free permanent hosting and GPU upgrades (NEW!), check out Spaces: <https://huggingface.co/spaces> (<https://huggingface.co/spaces>)

```
-----
timeout                                         Traceback (most recent call last)
File C:\ProgramData\Anaconda3\lib\site-packages\urllib3\connectionpool.py:4
49, in HTTPConnectionPool._make_request(self, conn, method, url, timeout, c
hunked, **httplib_request_kw)
445         except BaseException as e:
446             # Remove the TypeError from the exception chain in
447             # Python 3 (including for exceptions like SystemExit).
448             # Otherwise it looks like a bug in the code.
--> 449             six.raise_from(e, None)
450     except (SocketTimeout, ReadTimeoutError, SocketError) as e:
```

```
In [ ]:
```