Chest X-Ray Medical Diagnosis with Deep Learning - LUNG DISEASES (Convolutional Neural Networks , DenseNet)

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INTRODUCTION :-

We Explored medical image diagnosis by building a state-of-the-art chest X-ray classifier using Keras & Tensorflow !

We Pre-processed and prepared a real-world X-ray dataset from (nih) .

Used transfer learning to retrain a DenseNet model for X-ray image classification

Applied class imbalance handling

Measured diagnostic performance by computing the AUC (Area Under the Curve) for the ROC (Receiver Operating Characteristic) curve

Visualize model activity using GradCAMs.

We used Artificial Neural Networks , Specifically Convolutional Networks for the image classification Task!

Neural Networks Learn Using Back propagation & Gradient Descent , thereby updating the respective weights and biases as per the ground truth with respect to the loss function.

Mostly for classification tasks the Loss function used is “Cross-Entropy” rather than “MSE” since the output is categorical rather than continuous.

We’ve one-hot encoded the outputs and further put the DENSENET Model to Train by freezing the earlier “low -feature learning” layers and just training the end few layers (added new layers)

ALGORITHM :-

An artificial neural network is an interconnected group of nodes, akin to the vast network of neurons in a brain.

Here, each circular node represents an artificial neuron and an arrow represents a connection from the output of one artificial neuron to the input of another.

Proposed by Yan LeCun in 1998, convolutional neural networks can identify the number present in a given input image. Other applications using CNNs include speech recognition, image segmentation and text processing. Before convolutional neural networks, multilayer perceptrons (MLP) were used in building image classifiers.

Image classification refers to the task of extracting information classes from a multi-band raster image.

Multilayer perceptrons take more time and space for finding information in pictures as every input feature needs to be connected with every neuron in the next layer. CNNs overtook MLPs by using a concept called local connectivity, which involves connecting each neuron to only a local region of the input volume.

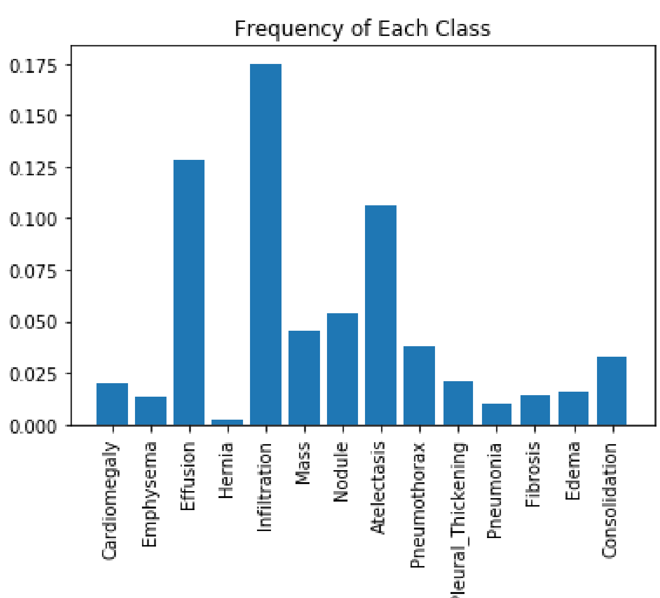
Chest X-Ray Dataset (nih) :-

The dataset contains 108,948 frontal-view X-ray images of 32,717 unique patients.Each image in the data set contains multiple text-mined labels identifying 14 different pathological conditions.These in turn can be used by physicians to diagnose 8 different diseases.

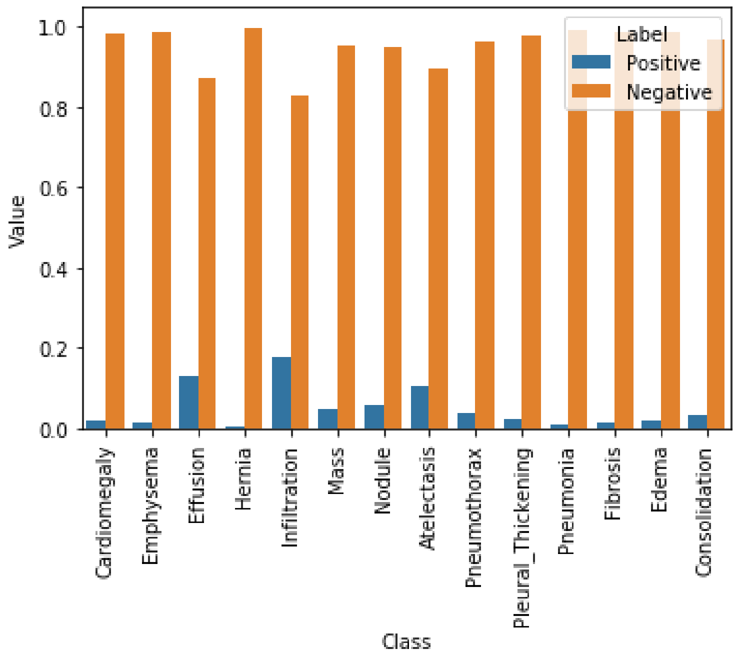
We will use this data to develop a single model that will provide binary classification predictions for each of the 14 labeled pathologies.

n other words it will predict 'positive' or 'negative' for each of the pathologies.

Graphs and plots *:-*

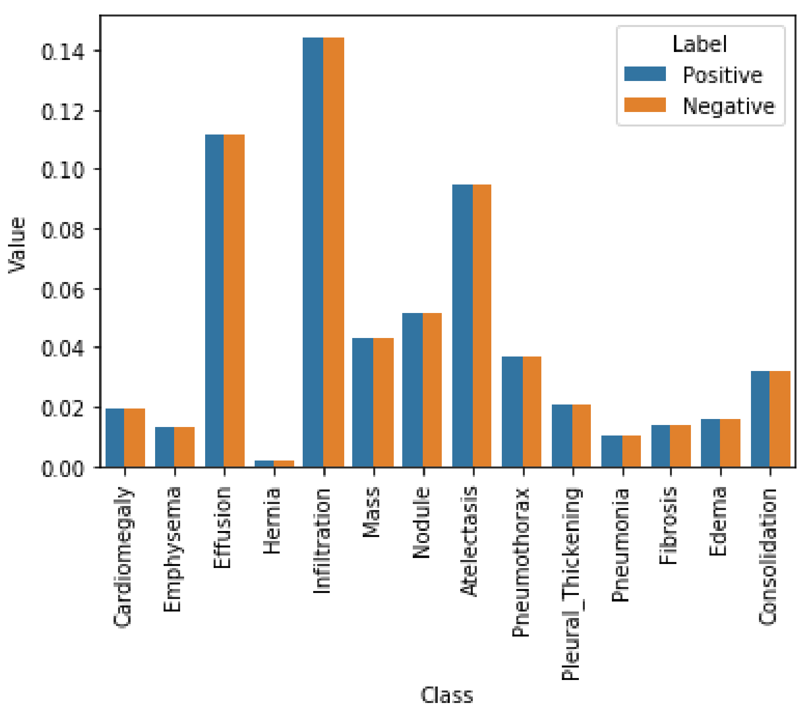


The Below bar chart shows the Frequency of types of Classes.

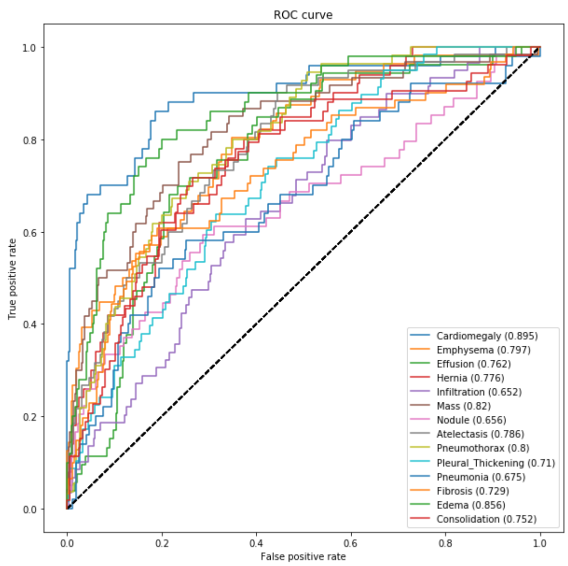


<u>The Bar graph shows the "Most Common" Class Imbalance Problem , which can lead to unwanted Biasing of our Model</u>

<u>The Current Bar Graph shows "Solved" Class Imbalance , using weighted positive and negative Frequency Calculation.</u>

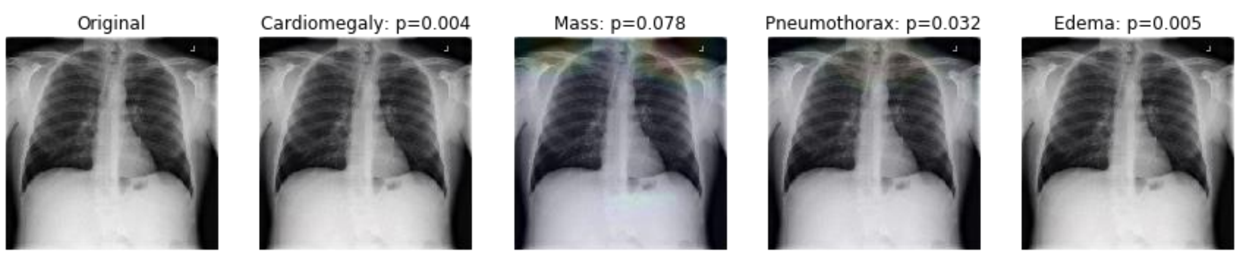


ROC (Reciver operating Characteristic) And AUROC (Area under ROC) Shows The True Positive and compares with the Flalse Postive , Thereby Showing the Efficiency of the model Built !



The Image Shows Probablistic Prediction Output of Different Classes of One Single Test !

From The Below its Clear that it Depicts "Mass" presence ! (GRADCAM)



INFERENCE :-

The model Is Used to train with the images from nih.

The dataset is labelled into 14 classes. The data is split into train, test and validation sets.

The labels are "one- hot Encoded".

The dense layer architecture being a bit too deep , is connected even after consecutive layers , hence increasing the feature learning capability of the model .

The model Learns most of the "deep" features within the given image , hence providing a "Good" Score in terms of Classifying images of lung !

The Loss Funciton used is Weighted Cross Entropy , Given by :-

$L_{wcross-entropy}(x) = -(w_p y \log(f(x)) + w_n (1-y) \log(1-f(x)))$.

The model Performs Very accurately , Showing minimal / No Bias at All.!

The Results are shown in The ROC / AUROC Curves !

Applications of The Algorithm:-

Convolutional Neural Networks have awide range of Applications such as :-

1.) Facial Recogniton

2.) Climate Understanding

3.) Autonomous Driving

4.) Medical Imagery

5.) Document Analysing