Pneumonia Prediction using chest X-Rays by applying CNN

Classification of Chest X-rays to predict if a given data sample has pneumonia.

COEN 240: Aman Nagarkar

Introduction

The goal of this project is to deploy a Convolutional Neural Networks on Chest X-Ray scans to detect which samples are from Pneumonia patients. This dataset (version 3) has two folders: one for the train set and one for the test set. In the notebook, the train folder is later split into train/validation sets.

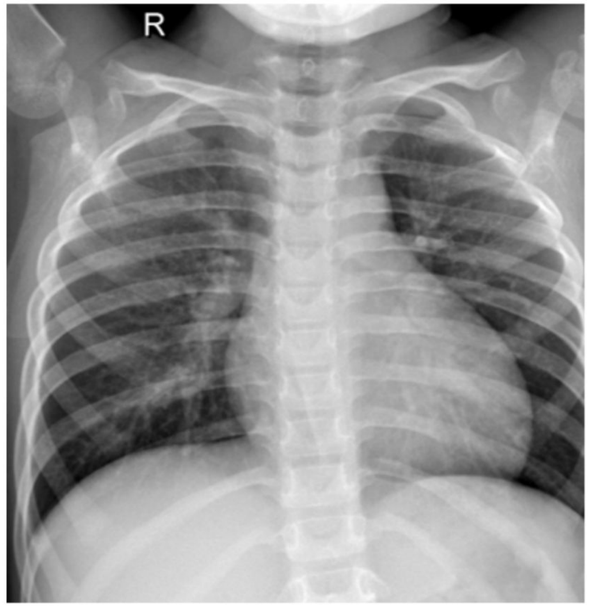
For image classification, I employ three methods:

1) A basic CNN.

2) Transfer Learning, which uses a pre-trained model with frozen layers for feature extraction.

3) Fine Tuning, unfreezing the pre-trained model's final layers.

Normal

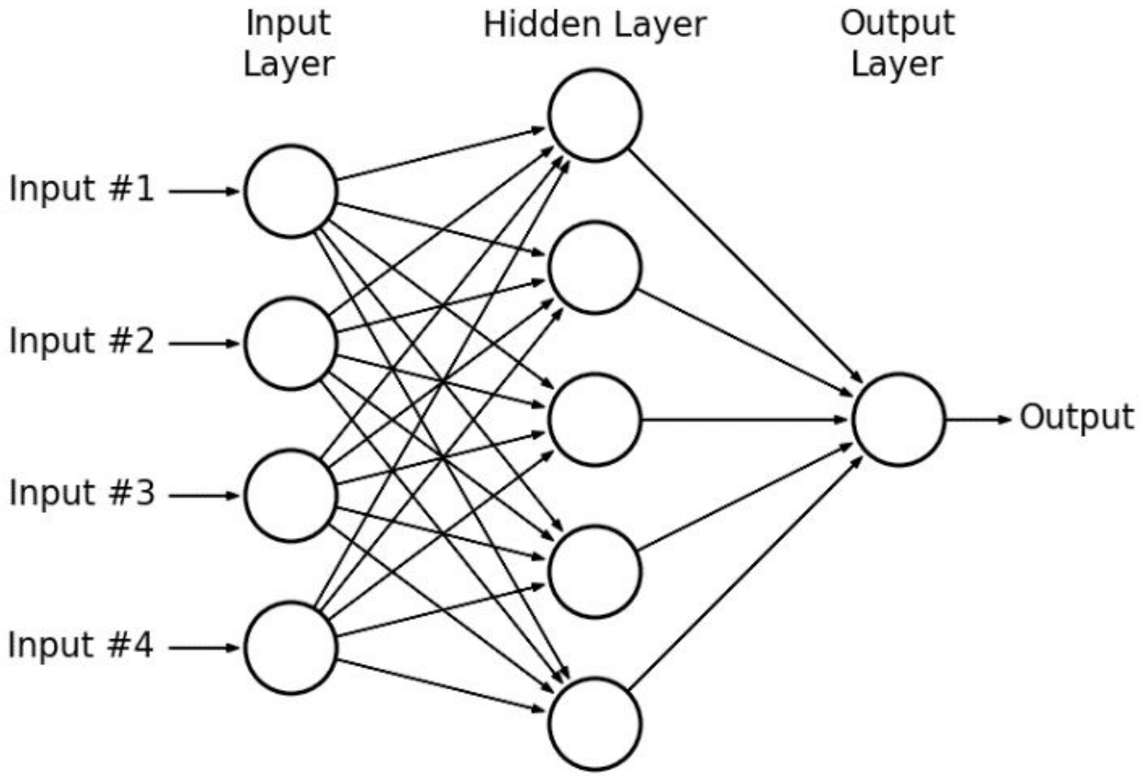


Pneumonia

Convolutional Neural Network

What is a convolutional neural network?

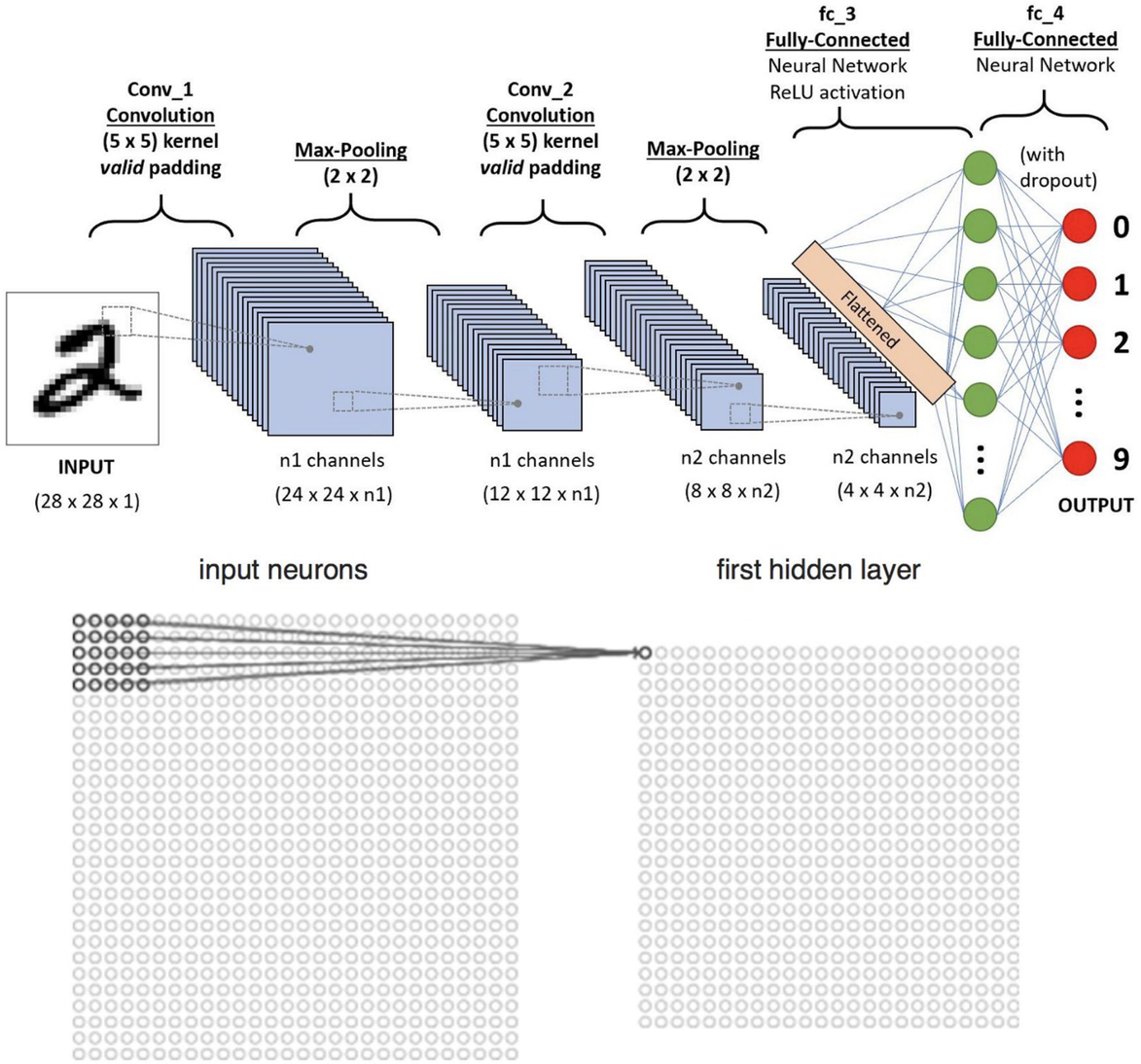
- A convolutional neural network (CNN, or ConvNet) is a class of artificial neural network, most commonly applied to analyze visual imagery. CNNs are regularized versions of multilayer perceptrons. Multilayer perceptrons usually mean fully connected networks, that is, each neuron in one layer is connected to all neurons in the next layer
- A CNN in a three layered network consisting of a convolutional layer, a pooling layer and a fully connected layer.
- Convolutional layer is the layer where filters are applied. The number and size of the kernels are a few important parameters passed in this layer.
- Pooling layers are similar to convolutional layers, but they perform a specific function such as max pooling, which takes the maximum value in a certain filter region, or average pooling, which takes the average value in a filter region. These are typically used to reduce the dimensionality of the network.
- Fully connected layers are placed before the classification output of a CNN and are used to flatten the results before classification.



How CNN is used in my project

Using Convolutional neural networks for image recognition.

- CNN uses some features of the visual cortex for image classification.
- The main task of image classification is acceptance of the input image and the following definition of its class.
- Instead of the image, the computer sees an array of pixels. For example, if image size is 28 x 28. In this case, the size of the array will be 28x28x1. Where 28 is width, next 28 is height and 1 is RGB channel values. The computer is assigned a value from 0 or 1 to each of these numbers. 0 is Black and 1 is white.
- The software selects a smaller matrix there, which is called a filter (or neuron, or core) and moves along the image multiplying the values. These are summed up and one number is obtained at the end. This forms the first hidden layer. Multiple such layers are connected till features are identified.
- After the features are identified, the layers are compressed to form an N dimensional vector, where N is the amount of classes from which the model selects the desired class.

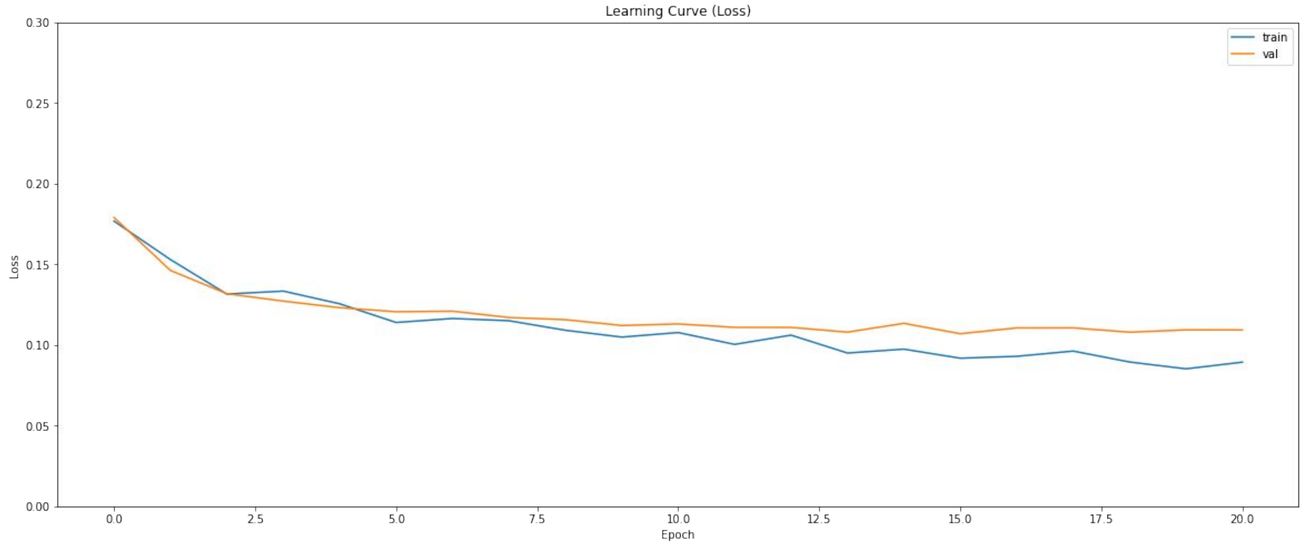


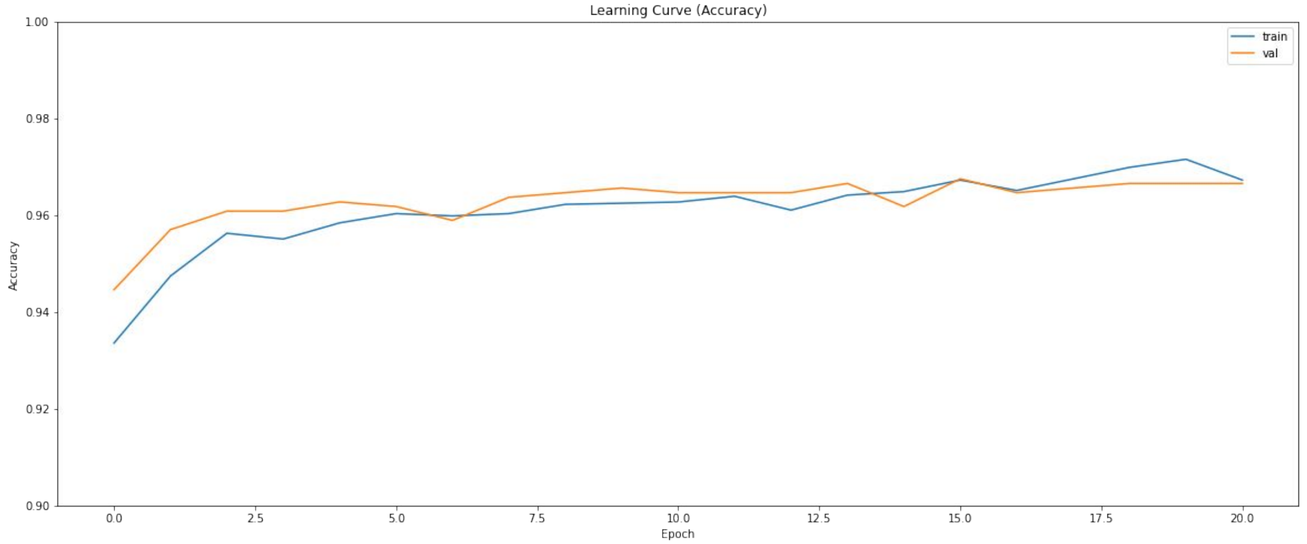
Performance metrics

The model's performance on the data.

Val loss: 0.10701081901788712
Train Loss: 0.219524335861206

Val accuracy: 0.9675262570381165
Train Accuracy: 0.9198718070983887

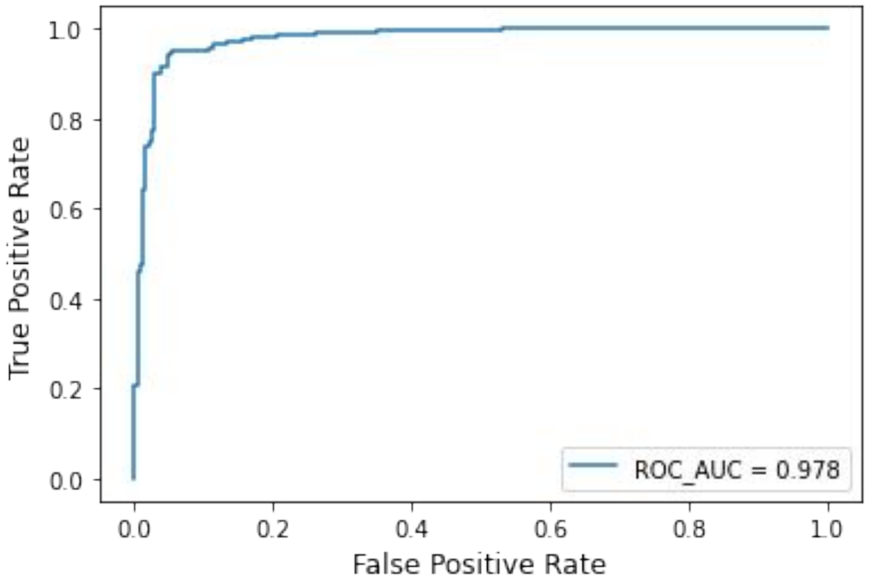




Performance metrics

The model's performance on the data.

	Negative	Positive	Weight Avg	Macro Avg
Precision	0.96	0.90	0.92	0.93
Recall	0.82	0.98	0.92	0.90
F1 Score	0.88	0.94	0.92	0.91
Support	234	390	624	624



97.8%

This is the model's prediction accuracy on the true positives in testing dataset. The recall was close to 100%. Even without expertise on the medical field, it's reasonable to assume that false negatives are more 'costly' than false positives in this case. Reaching such recall with a relatively small dataset for training as this one, while also reaching a pretty good recall, is a good indicative of the model's capabilities. Such capabilities are also confirmed by the high ROC-AUC value.

Thank You