Comparing a Fully Connected Neural Network to a Convolutional Neural Network in Classifying Pneumonia from X-Rays

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Abstract:

Introduction:

Applications of machine learning is becoming increasingly popular and important in the world of medical imaging. Algorithms like convolutional neural networks (CNN’s) and fully connected deep learning neural networks can be extremely accurate in diagnosing images where disease is present.

Methods:

There were many methods considered throughout the process of detecting pneumonia in the given x-ray images of lungs. The two algorithms we will be applying to this problem are a fully connected deep learning neural network, in which deep learning classifies the network as having many hidden layers, and a convolutional neural network, which also falls under the category of deep learning and is widely us in image classification problems.

The data was obtained from Kaggle and contains x-rays of lungs, some of which are normal lungs (absence of pneumonia) and the others have pneumonia. Further, the lungs with pneumonia are classified as caused from bacteria or a virus. This distinction can be important when considering the problem of overfitting from class imbalance. There are 624 images in our testing set and 5216 images in the testing set. Within the training images, 1341 are classified as normal, 2530 as bacteria, and 1345 as virus. From here, we can decide to treat our data as having two classes, normal or pneumonia, or we can treat it is as three classes, normal, bacteria, virus. In attempt to avoid overfitting from the class imbalance, in which we would have about one-third normal images and two-thirds pneumonia images, we will first build our model with three separate classes then compare to a model if we treated the data as two classes.

In order to prepare the data, we search the file name to determine which images are bacterial pneumonia and which are viral pneumonia. This can be done with a simple regular expression which searches the file name for a key word. Next, we need to read in our images. However, there are a few problems with the images. First, all of the images are different sizes which won’t work for our models since they will expect each input to have the same number of pixels, and second, some images were created as grey scale and the other as color. This is a problem only encountered by the code because to the naked eye, all images look black and white. The images that are ‘color’ meaning they have three bands (RGB) instead of one, create problems when we try to resize the image. To bypass this problem, we convert all of the images to greyscale then resize them to the new desired width and height.