Analysis of Efficient Net CNN model on luna16 extracted lung nodule patches

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***Abstract*—Convolutional neural networks are used in many applications giving excellent predictions. These networks with their ability to make external predictions, when used on medical data can help in the detection of cancer. Lung cancer is a very dangerous and life-ending disease. By training the convolutional neural networks on the lung CT scan data. The trained model can be used to classify the nodules as benign or malignant.**

***Index Terms*—Lung cancer detection, Luna16, Convolutional Neural Network**

I. INTRODUCTION

Lung cancer is a deadly illness that affects humans. Lung cancer accounts for 5.9 percent of all cancers and 8.1 percent of all cancer-related fatalities in India [1]. The National Cancer Institute launched the National Lung Screening Trial (NLST) in 2002, which demonstrated a 20% reduction in lung cancer-related mortality rates when patients were tested with low-dose computed tomography rather than chest radiography [2]. Computer-aided diagnosis (CAD) technology has been created to ease physician burden while improving diagnostic accuracy and efficiency [3]. Using convolutional neural networks can help detect cancer nodules accurately.

II. RELEVANT KNOWLEDGE

Convolutional Neural Network

Convolutional Neural Networks are commonly employed in the field of machine vision tasks to extract essential information from images. CNN operated similarly to a sliding window, where a weight matrix (kernel) of size pxp slides from the top left to the bottom right of an image whose visual information must be extracted. The weight matrix M consists of integers that convolve to the image's pixel values (Type relevant info more). After learning, updated weight matrices are backpropagated to reassign the matrix's integer values (weight) to achieve better learning.

EfficientNet

EfficientNet is a convolutional neural network design and scaling approach that uses a compound coefficient to consistently scale all depth/width/resolution dimensions. It employs the compound scaling approach, which, in contrast to normal practice, uniformly scales network breadth, depth, and resolution using a set of fixed scaling coefficients. When compared to alternative single-dimension scaling approaches, the EfficientNet compound scaling method enhances the accuracy of all of these models, implying that our suggested scaling strategy is useful for general current ConvNets. All EfficientNet models are scaled from our starting point EfficientNet-B0 with various compound coefficients [4].

III. EXPERIMENT

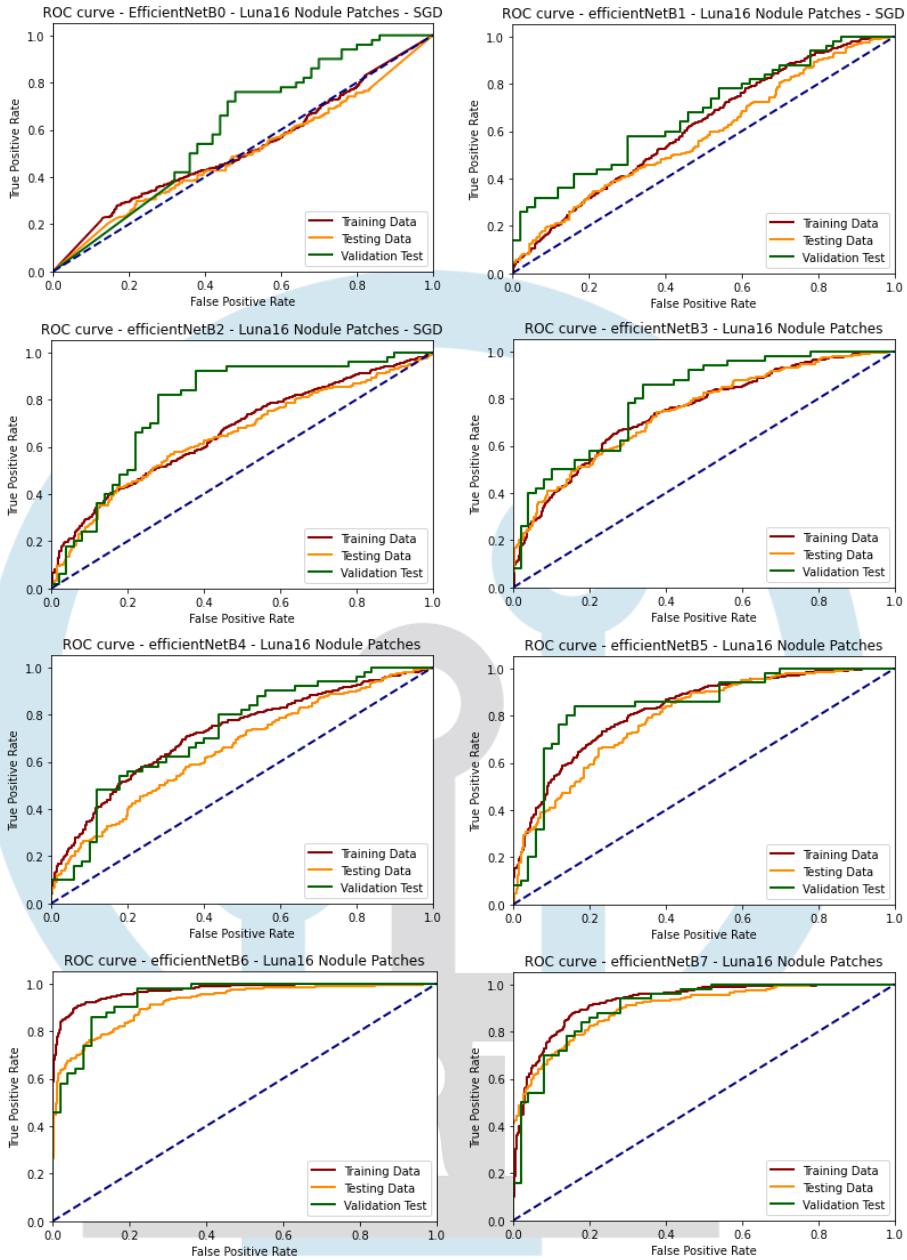
Preprocessing and Experiment

Luna16 dataset contains 888 CT scans. Each of these CT scans has a various number of slices whose sizes are 512x512. These slices contain the lung nodules at various locations. The Luna16 dataset contains the location of nodules in world coordinates. The world coordinates are converted into voxel coordinates which is then used to locate the location of the nodule. Then an area of 65x65 is snipped around the location. Using the nodule location data, benign and malignant nodule patches of 65x65x1 were extracted. The image was resized to 65x65x3. In total there were 900 malignant nodules and 1400 benign nodule patches. This data was split into train, test, and validation in a ratio. This train data was fed into efficientnet convolutional neural network model. Stochastic gradient descent was used as an optimizer. The learning rate was set to 0.0001. The model was run for 20 epochs. Each individual efficient model's f1-score, precision, and accuracy were recorded. The respective efficientnet model ROC curve was recorded.

Results

The initial hypothesis was when the model scaled up, the model classification accuracy improved. This was not the case though, the model started performing badly from Efficientnet-B0 to EfficientNet-B2.

Figure 1 ROC curve of EfficientNet B0-B6 neural architectures on Luna16 lung nodule patch data



IV. Conclusion

This paper focuses on the application of EfficientNet Convolutional Neural Network architecture's performance on the classification of lung nodules as benign or malignant. The model performs well in classifying the lung nodules as the model passes from B0 to B7th model. Initially, the first model B0 had large false positives and false negatives. As the model progressed to B7, the model showed lesser false positives and lesser false negatives.

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