Lung Cancer Nodule Detection using Low Memory Deep Neural Networks

OVERVIEW:

Our project aims to compare performance of various light weight, low memory Deep Neural Networks (SqueezeNets and MobileNets) which are a novelty for biomedical image analysis in order to detect the presence of cancerous nodules in patient CT scans of lungs with and without early stage lung cancer.

DATA:

LUNA16 dataset with 551,065 3D images of size (512 x 512).

For each patient the data consists of CT scan data and a label (0 for no cancer, 1 for cancer).

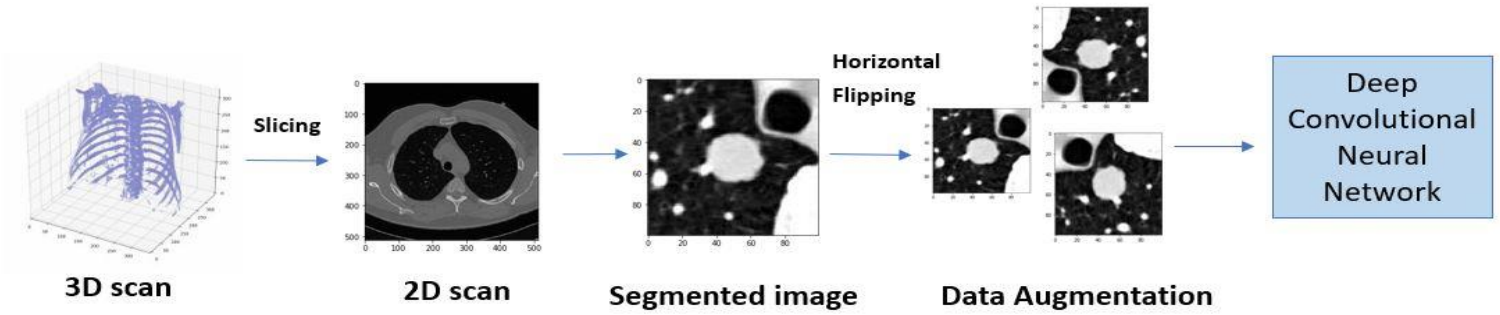
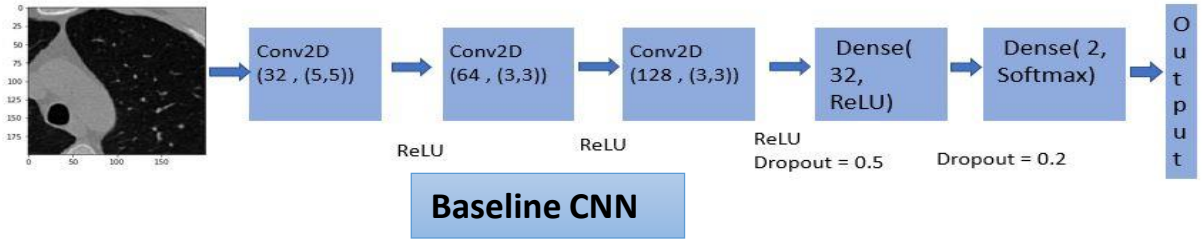


IMAGE PREPROCESSING:

We preprocess the 3D CT scans using segmentation, normalization, down- sampling, and zero-centering.

Class Imbalance is tackled using data augmentation.



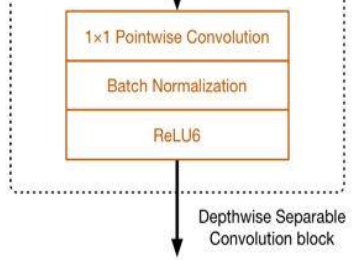
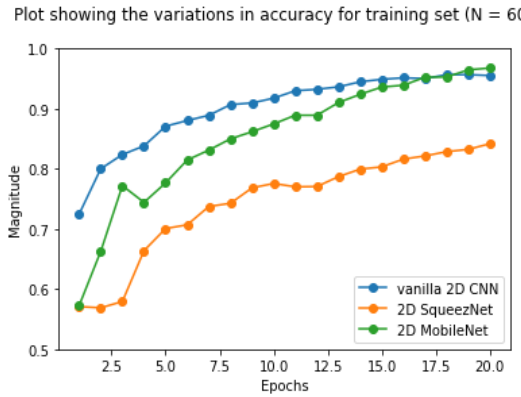
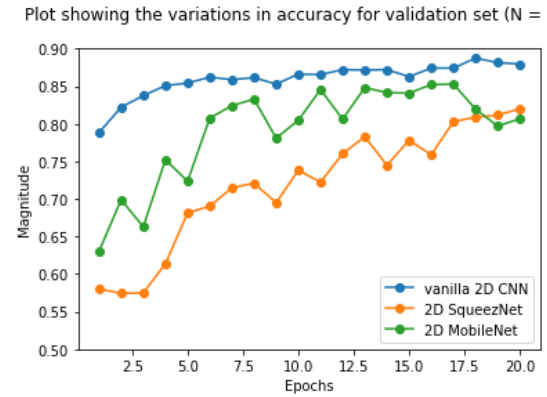


IMAGE CLASSIFICATION:

It is our aim to observe the deeper CNN's and analyze the variability of these networks in medical image data.
We are evaluating the performance of vanilla 2D CNN, 2D SqueezeNet, 2D MobileNet (each denser than the other).
Introducing class weights improvises performance.

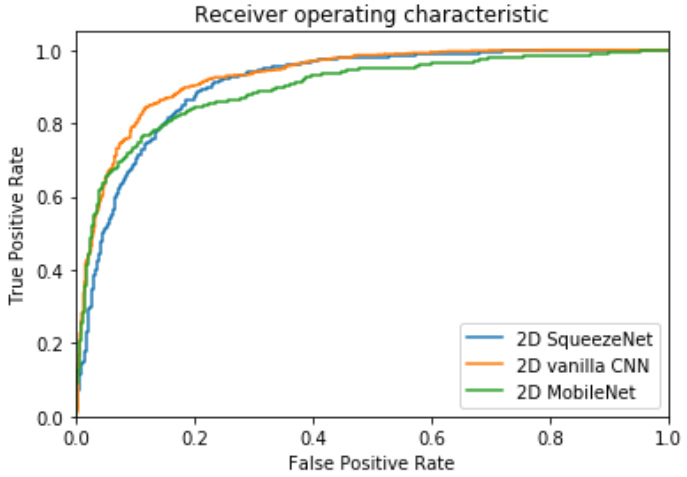




Performance Statistics

Model	Acc	Specificity	Sensitivity	AUC score
Baseline CNN	89.921	0.877	0.838	0.9209
SqueezeNet	85.212	0.883	0.874	0.9019
MobileNet	86.315	0.765	0.916	0.8919

Accuracy, Sensitivity and Specificity



ROC curve for the 3 nets

RESULTS:

SqueezeNet has the best trade- off between sensitivity and specificity though it's accuracy might be low.
This project is significant as SqueezeNets and MobileNets aren't widely renowned networks for analysis of biomedical images.

FUTURE WORK:

To adapt the networks to predict using 3D volumetric slices. Improvise the segmentation techniques .
Use the brightness of pixels for identifying nodule locations.

References:

- MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications Andrew G. Howard, Menglong Zhu, Bo Chen, Dmitry Kalenichenko, Weijun Wang, Tobias Weyand, Marco Andreetto, Hartwig Adam
- SqueezeNet: AlexNet-level accuracy with 50x fewer parameters and <0.5MB model size
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