The Basic Classification of Thyroid Tumors on UltraSound Images using Deep Learning Methods

Dataset

Colombia National University presented an open access database of thyroid ultrasound images. The dataset consists of a set of B-mode Ultrasound images, including a complete annotation and diagnostic description of suspicious thyroid lesions by expert radiologists.

The dataset is unbalanced ,and there are some images which include non-labeled thyroid tumors. Also, some images consists of two thyroid ultrasound image of same patient.In these issues, the main tough problem is unbalancing. We can handled easily images' issues. However ,to solve unbalancing issue of the dataset, we should examine this issue under three main idea which are :

- Regularizition of Dataset (Data Augmention etc.)
- New Algorithms (Loss Functions, Optimizers, reconsidering bias etc.)
- Hybrid Solutions

Note:

There are text about classification of thyroid tumors on images. They must be deleted for real result.

Methods

The purpose is the classification of thyroid tumors on ultrasound images with 6 different classses:

- 1 (Benign)
- 2 (Benign)
- 4a (Malign)
- 4b (Malign)
- 4c (Malign)
- 5 (Malign)

In this line ,we used VGG19 CNN model which has high parameters. The activation function of last layer was "softmax" for multi-classification. We used "Categorical Cross-Entropy Function" for loss function. Also, in fully connective layers, we used L1-L2 regulazier to prevent overfitting .

In data preperation ,firstly , we normalized images . Secondly, we cropped images to find to the biggest coutour of image.

We trained with 35 epochs and 16 batch size.

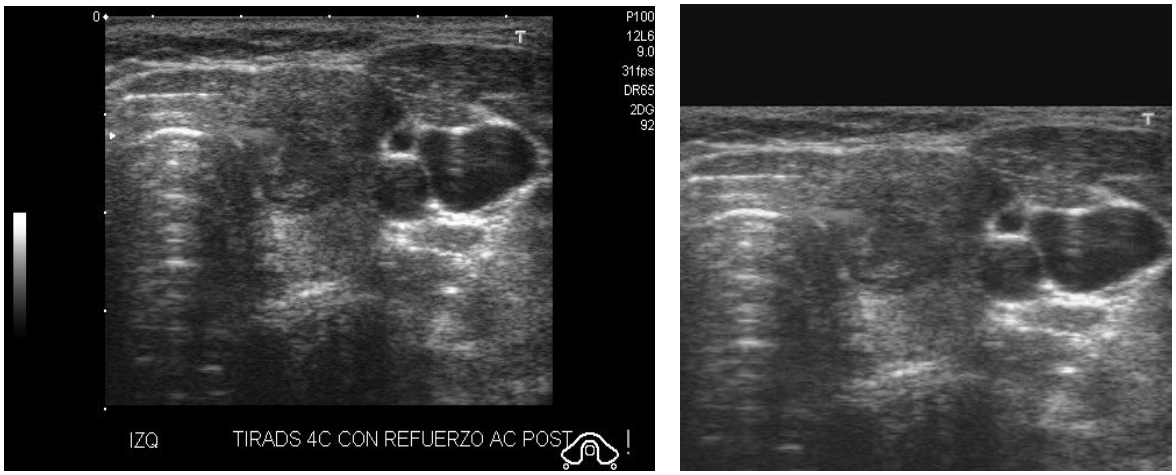

Figure 1 – Original Image and Cropped and Resized Image which has given to model

Results

AUC - ROC curve is a performance measurement for the classification problems at various threshold settings. ROC is a probability curve and AUC represents the degree or measure of separability. It tells how much the model is capable of distinguishing between classes. Higher the AUC, the better the model is at predicting 0 classes as 0 and 1 classes as 1. By analogy, the Higher the AUC, the better the model is at distinguishing between patients with the disease and no disease.

Our AUC score is 0.734. ROC curve and AUC score are the most important metrics for the image classification.

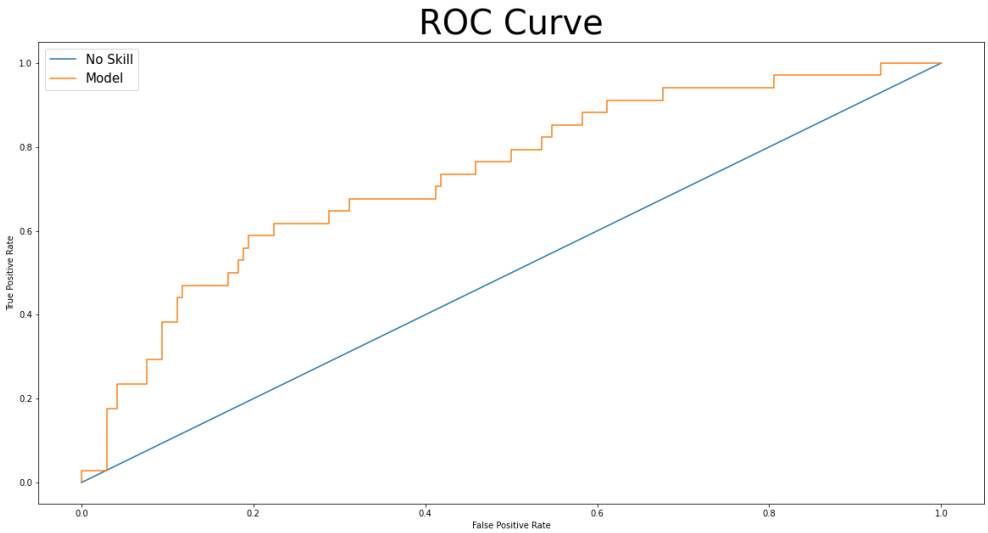

Figure 2 – Roc Curve

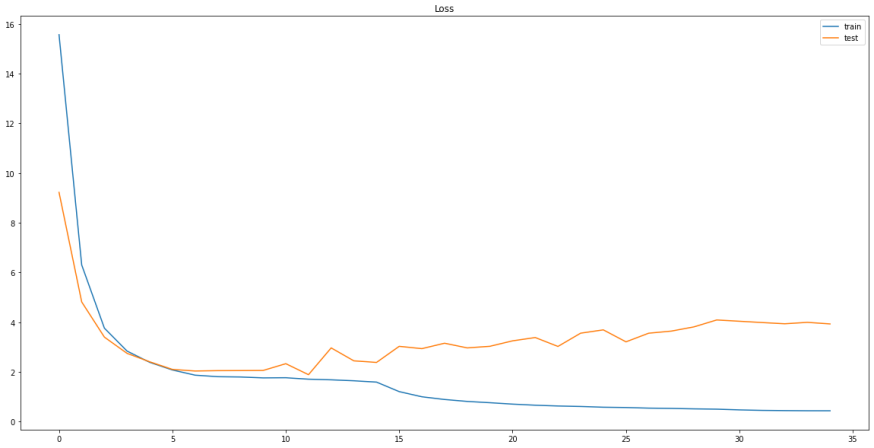

Figure 3– Losses of train and test

Grad-CAM is a strict generalization of the Class Activation Mapping. Unlike CAM, Grad-CAM requires no re-training and is broadly applicable to any CNN-based architectures. We also show how Grad-CAM may be combined with existing pixel-space visualizations to create a high-resolution class-discriminative visualization (Guided Grad-CAM).

We used GradCam to examine results.

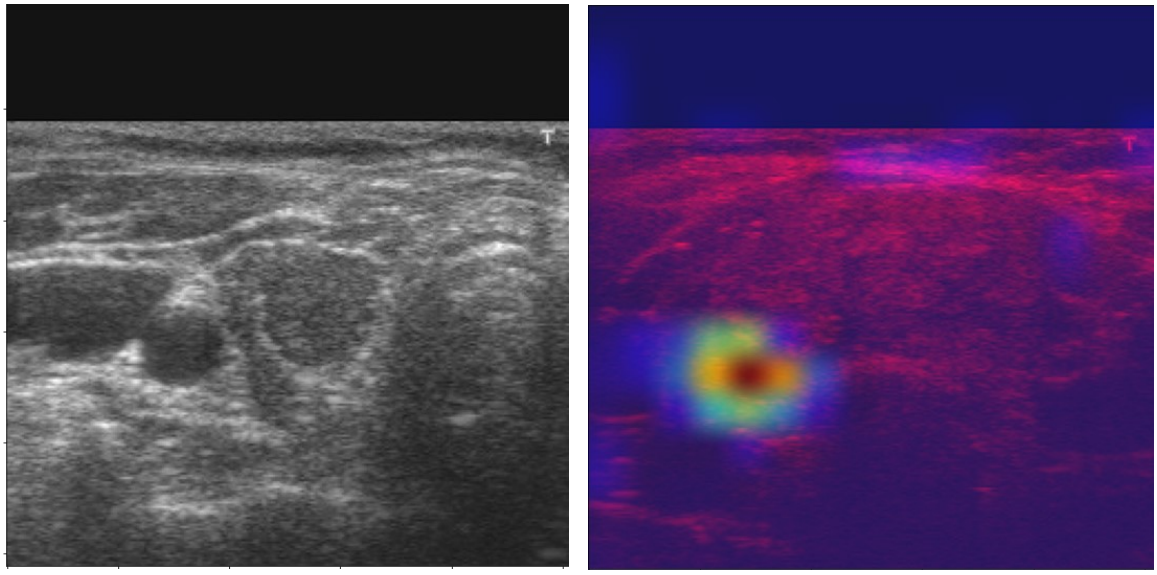

Figure 4– Original Image and GradCam Result

In figure 4 , as you can be seen, the model targetted tyhriod tumor for classification.

Conclusion

For the better results , we need to handle unbalancing issue in dataset.Under “Dataset” title , we explained solutions , you can examine . Other problem is that there are images which have two ultrasound images. They should be splitted. Also, we can use different CNN models like EfficientNet , Inception+Resnet etc. Nowadays ,these models are very popular, effective.Finally , we can train with more epochs.

In the real-life , the classification alone is not enough. We need Object Detection models.With these models, we can easliy segment and classify tumors.