WID3008 Image Processing

Assignment Step 3 Report

Title: COVID-19 Detection with Radiography Images

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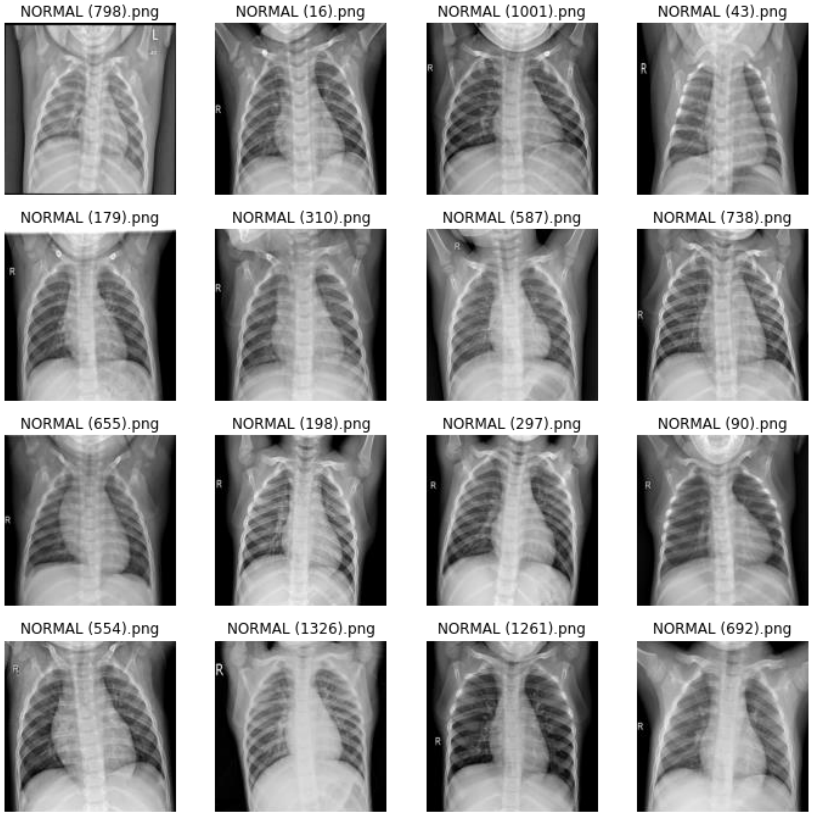
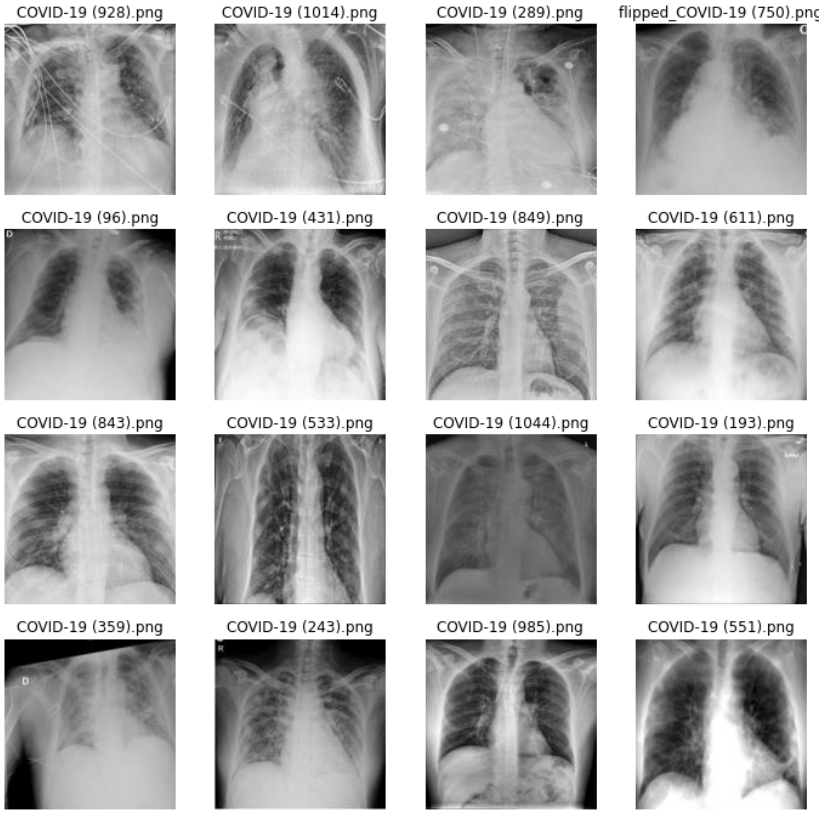
https://github.com/zhiqin1998/covid19-detection

Datasets

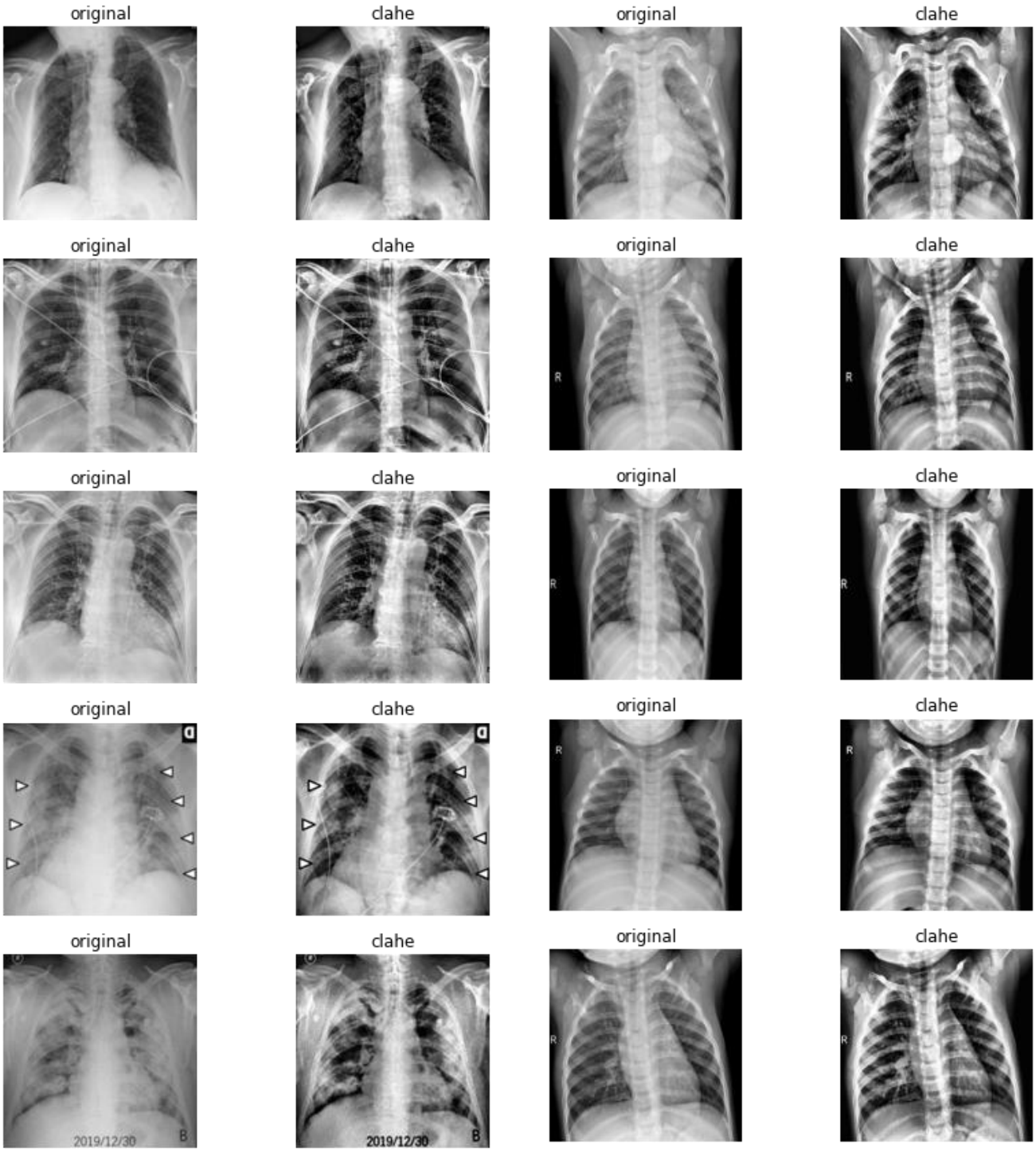
Datasets are obtained from Kaggle https://www.kaggle.com/tawsifurrahman/covid19-radiography-database. Below are a few training images examples





Pre-processing

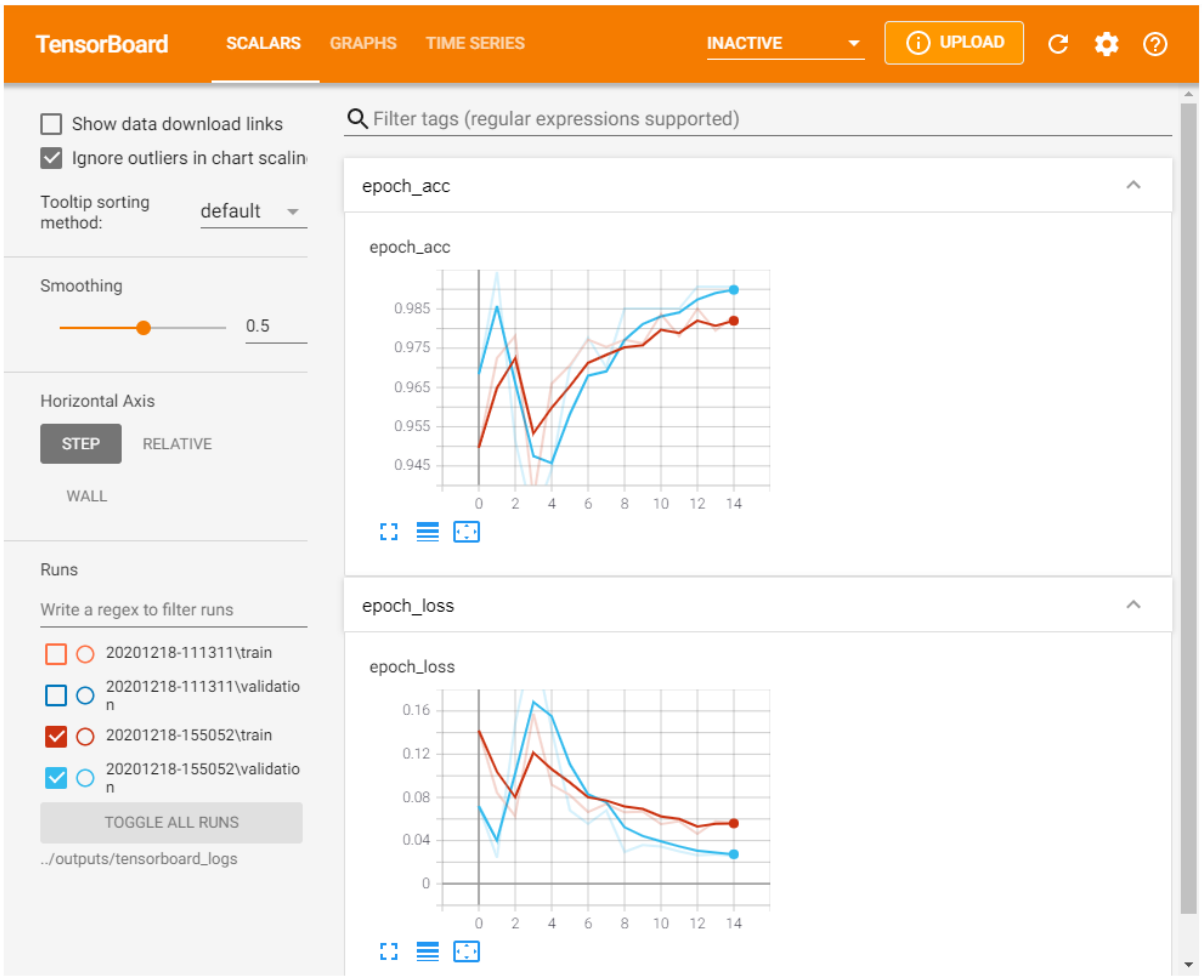
The most important pre-processing steps here is to enhance the image using Contrast Limited Adaptive Histogram Equalization (CLAHE). CLAHE is an algorithm which is a variant of adaptive histogram equalization in which the contrast amplification is limited to reduce noise amplification. It operates on small regions in images, called tiles. The neighboring tiles are then combined using bilinear interpolation to remove the artificial boundaries. This algorithm is applied to improve the contrast of images. Below are the results of CLAHE:



Training Results

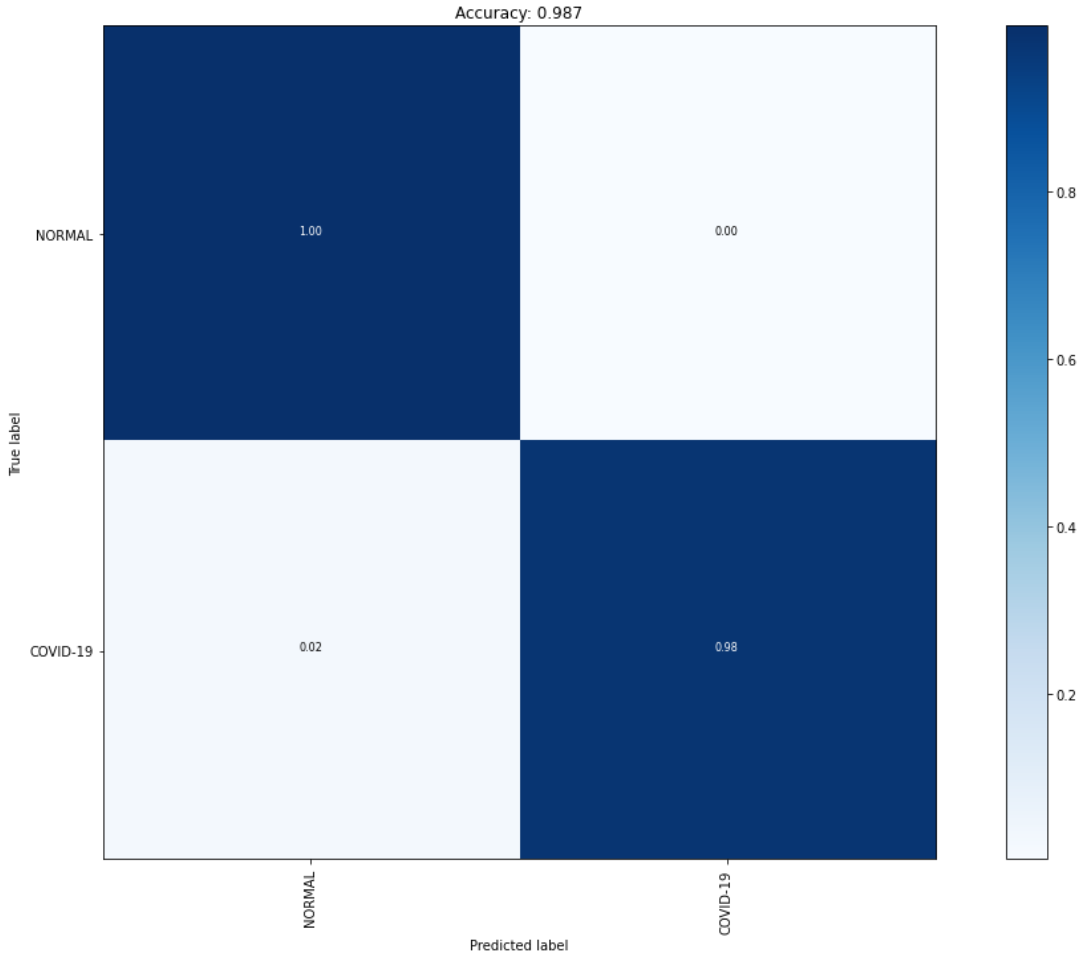
Epoch Plots

The loss and accuracy epoch plot are made with TensorBoard. The head of model is trained for 3 epochs then train the last few inception block until 15 epochs. Overall, the epoch plot looks good with a good fit. (No underfit or overfit). The small spike at epoch 3 is because we unfreeze the last few inception block and the parameters are retrained. The final validation loss is 0.0258 and the final validation accuracy is 0.9907.



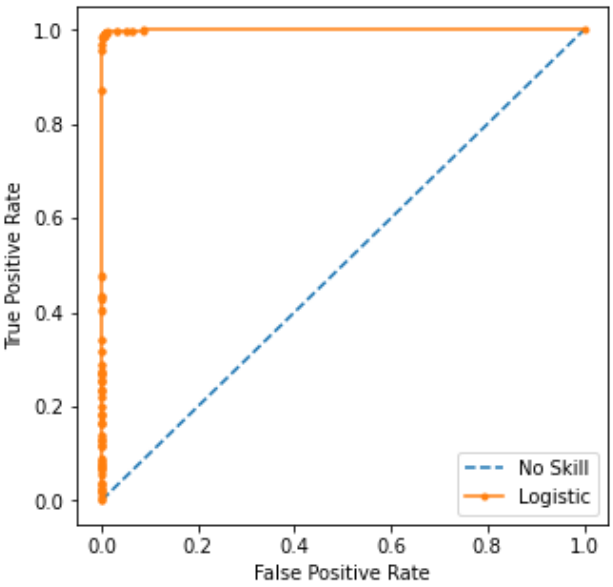
Confusion Matrix

From the confusion matrix, we can see that only 2% of the time when our model predicts NORMAL class, it is a wrong prediction.



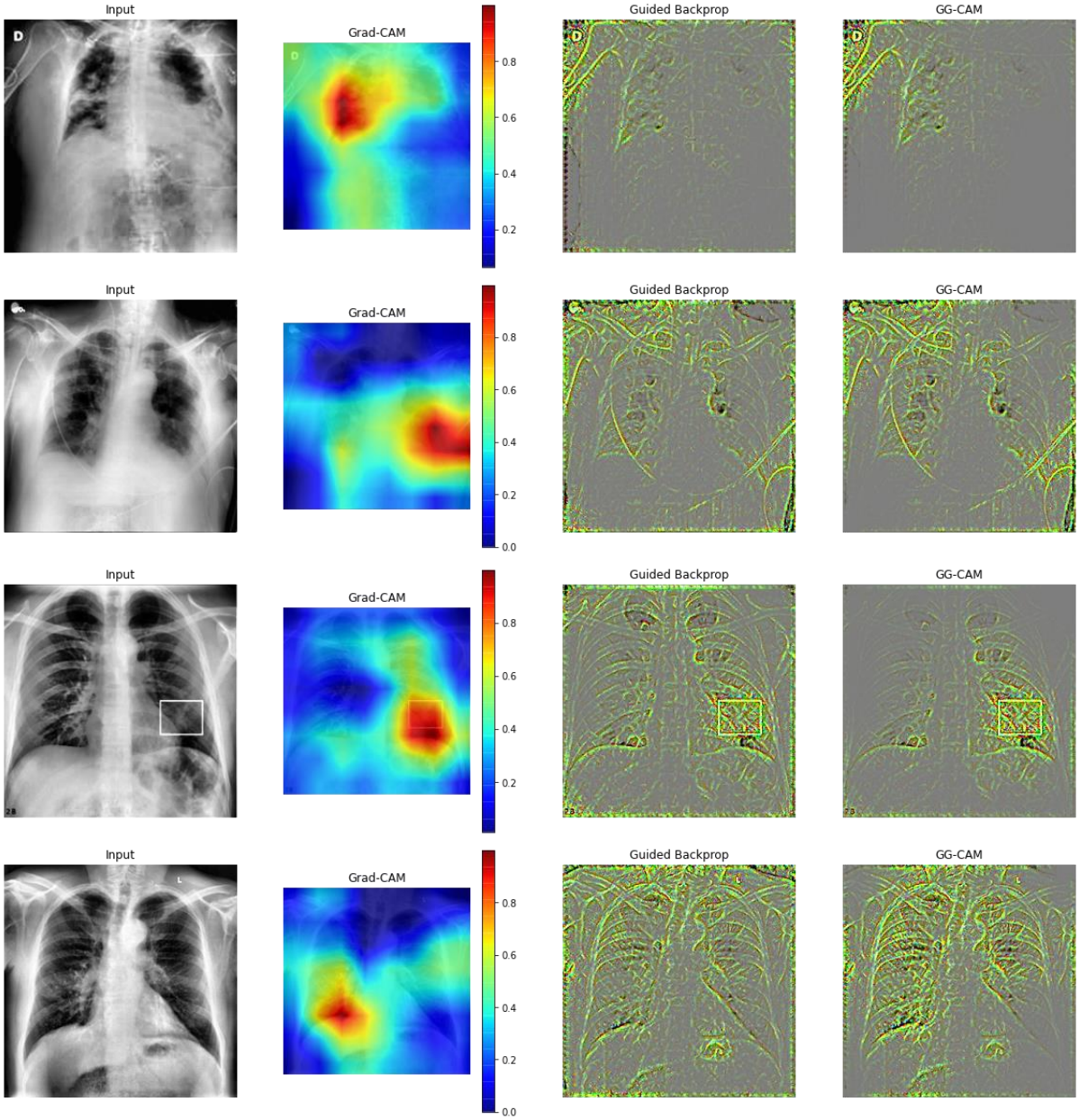
ROC Curve

To interpret a ROC curve, the curve closer to the top-left corner indicate a better performance, while closer to the diagonal means less accurate model. The graph is expected given the high precision and recall rate of our model.



Guided GradCAM

Guided gradient-weighted class activation mapping is a method to visualize region of inputs that are "important" for getting the final class predictions. GradCAM produces a heatmap that indicates important regions while Guided GradCAM combines the heatmap with a saliency map produced by guided backprop.



We can observe that some of the COVID-19 images has boxes that indicates the effects of COVID-19 disease (fluid, debris, pneumonia) and our model successfully learnt how to identify those effects.