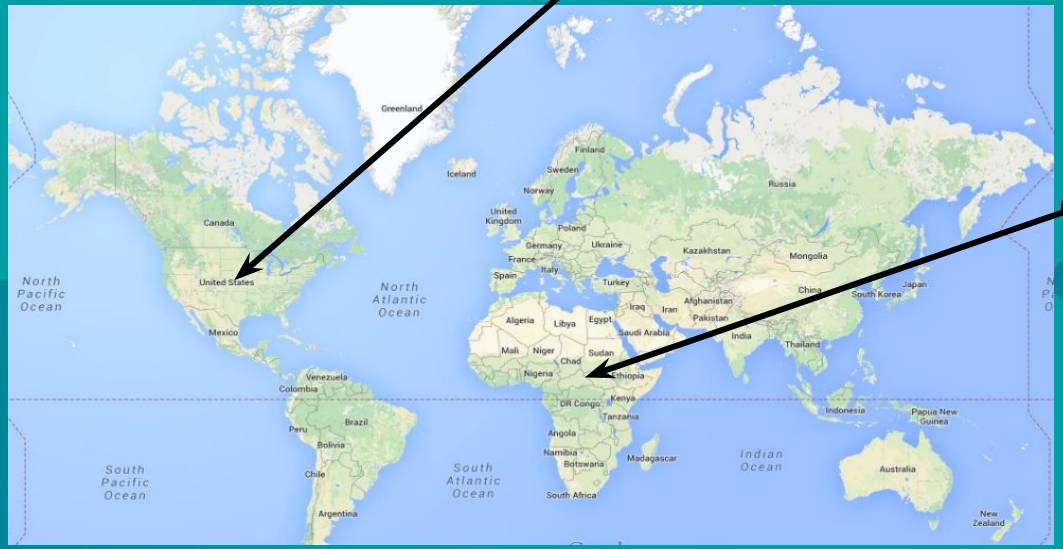
DIAGNOSING LUNG DISEASES USING DEEP LEARNING

By Ari Iwunze

Why Lung Diseases?

Pneumonia is the cause of 1 out of 6 childhood deaths, making it the leading cause of fatalities in children under 5 years

In the United States,
The death rate of pneumonia is 10 out of every 100,000 individuals



In Africa,
The death rate of pneumonia is 100 out of every 100,000 individuals

100,000

Deaths per year due to the misdiagnosis of pneumonia

Misdiagnosis

- *Wrongful diagnosis of pneumonia can be very life threatening given that it leads to an increase in severity due to lack of treatment. Especially in cases where the patient might have a more serious infection like COVID-19.*

- *Why so many misdiagnosis?*
  - *Such errors are causes by rushing patents through examinations especially now during the times of COVID - 19.*
  - *It can also be due to the health workers who often possess low education levels which causes them to lack the required knowledge for recognizing pneumonia.*

TREATMENT

VIRAL

Antiviral medications will be prescribed to the patient.

BACTERIAL

Antibacterial medications will be prescribed to the patient.

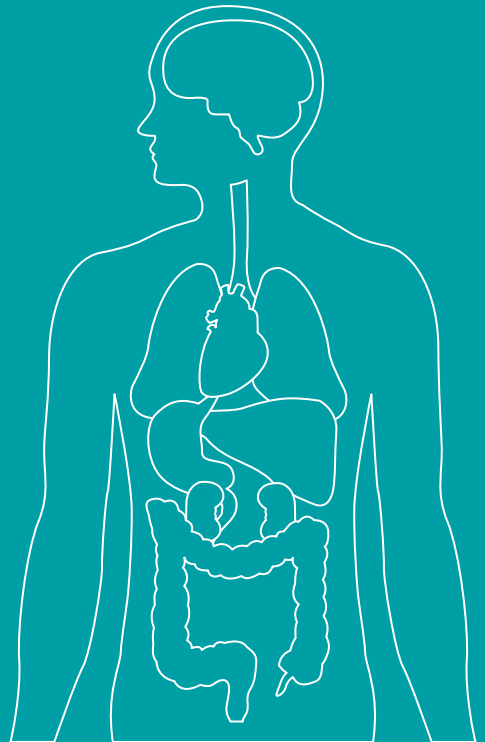
WALKING & CHEMICAL

Rest, antibiotics, anti-inflammatory drugs, steroids, etc.

PNEUMONIA TIME SCALE

More deadly if younger than 5 years of age or older than 65

People most-likely recover when diagnosed and treated properly



WEEK 1

30%

Temperature should have reduced.

WEEK 4

50%

Mucus and chest pain should have reduced.

WEEK 6

70%

cough and breathlessness should’ve reduced.

WEEK 12

90%

Most symptoms should have subsided by now.

Using the Kaggle's Image Dataset With X-Rays of Patients who Tested Both Positive and Negative For Pneumonia & Covid-19

38% Chest X-Rays showing normal lungs

24% Chest X-Rays showing lungs infected with Covid-19

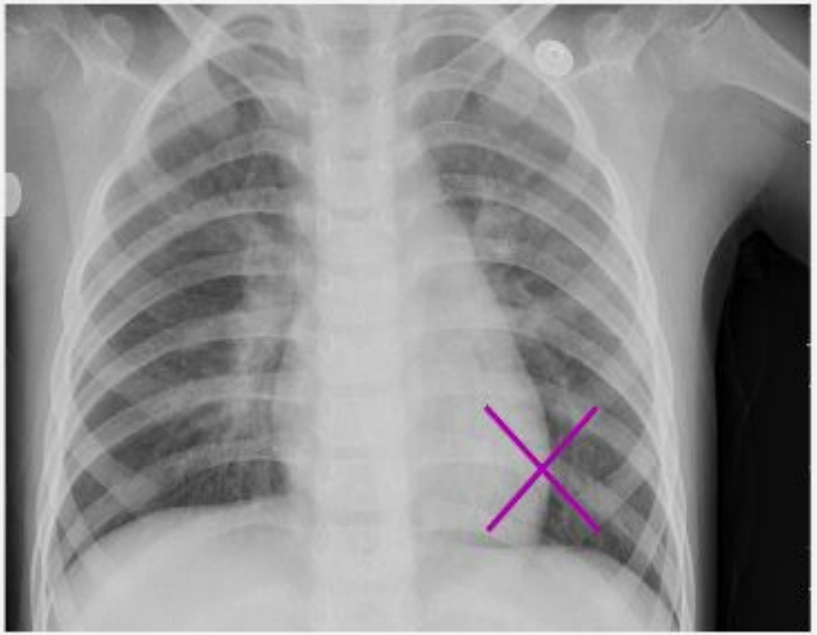
38% Chest X-Rays showing lungs infected with Pneumonia

TOTAL: 3,554

Physical Examination

NORMAL

PNEUMONIA



Results - Pneumonia

ACCURACY

The accuracy is 90% and this is the amount of time the predicted result is actually correct.

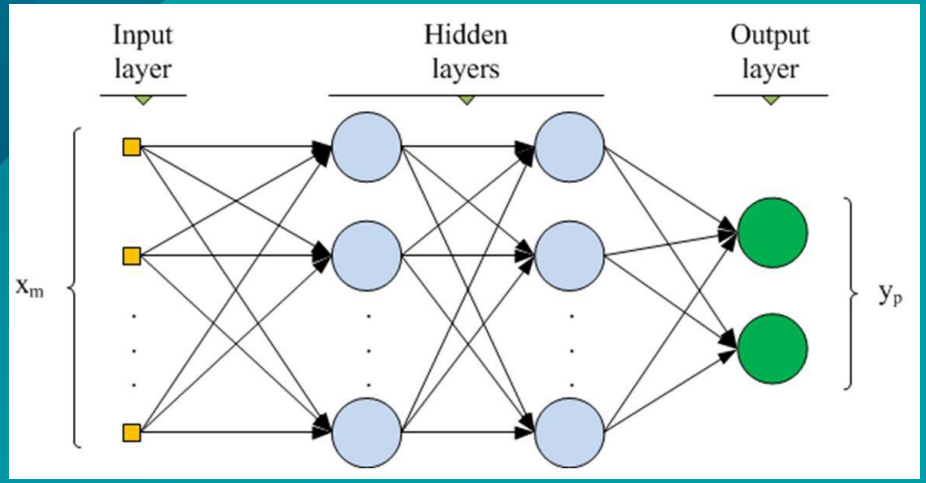
LOG LOSS

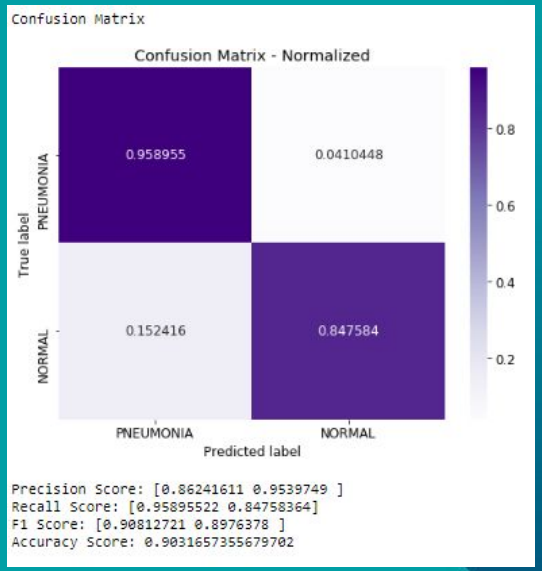
The model loss is 0.32 out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall percentage is 90% and this is the probability of the model diagnosing a correct positive diagnosis out of all the times it diagnosed positive.

Using A Base CNN Model





Results - Pneumonia

ACCURACY

The accuracy is 95% and this is the amount of time the predicted result is actually correct.

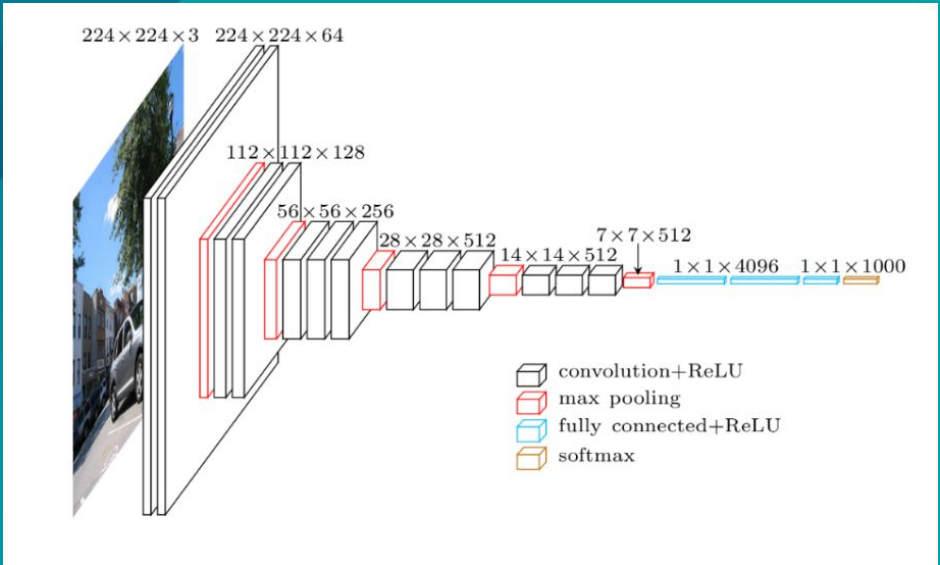
LOG LOSS

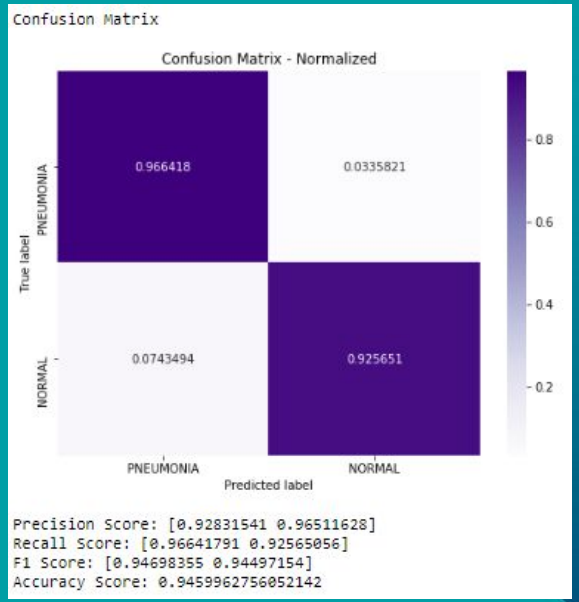
The model loss is 0.17 out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall percentage is 95% and this is the probability of the model diagnosing a correct positive diagnosis out of all the times it diagnosed positive.

Using VGG19 Transfer Learning Model





Results - Covid-19

ACCURACY

The accuracy is 97% and this is the amount of time the predicted result is actually correct.

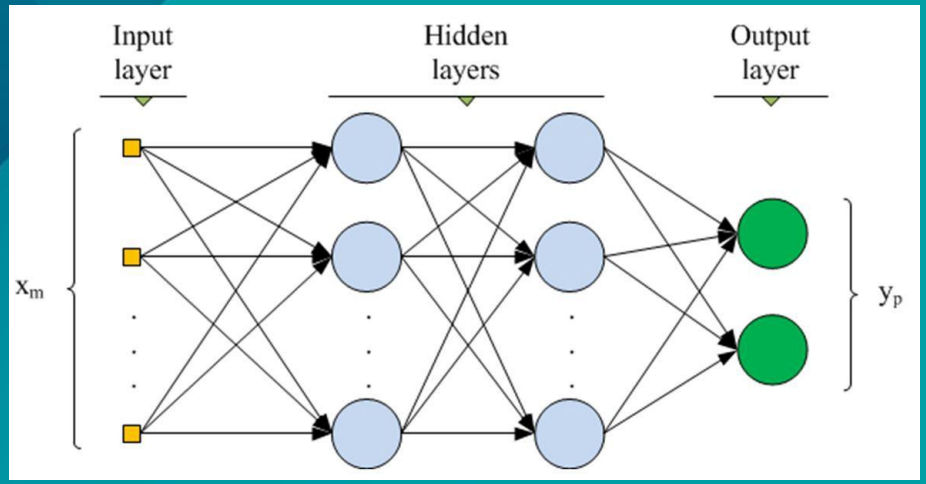
LOG LOSS

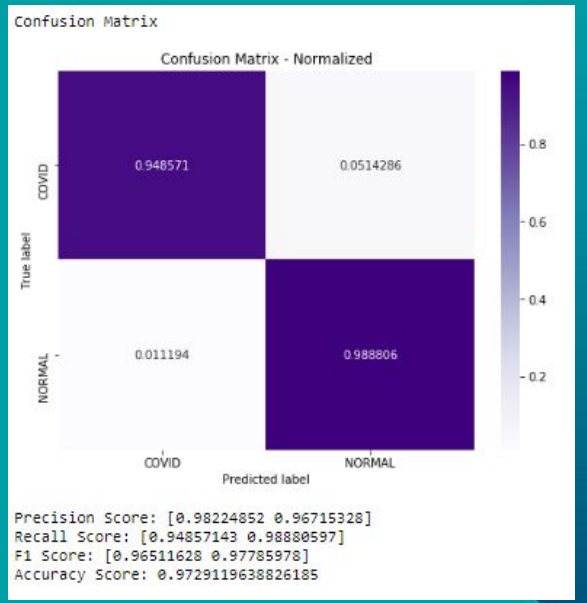
The model loss is 0.32 out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall percentage is 97% and this is the probability of the model diagnosing a correct positive diagnosis out of all the times it diagnosed positive.

Using A Base CNN Model





Results - Covid-19

ACCURACY

The accuracy is 99% and this is the amount of time the predicted result is actually correct.

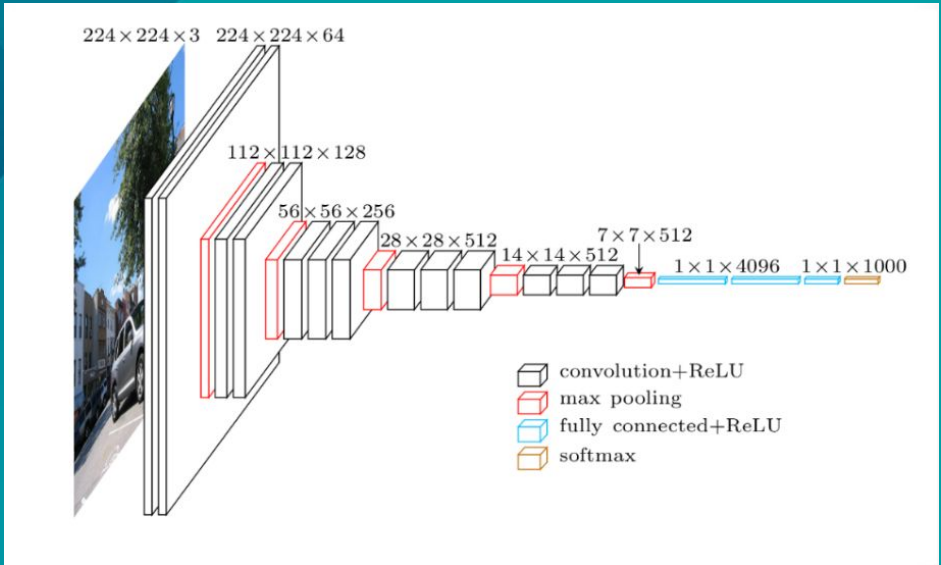
LOG LOSS

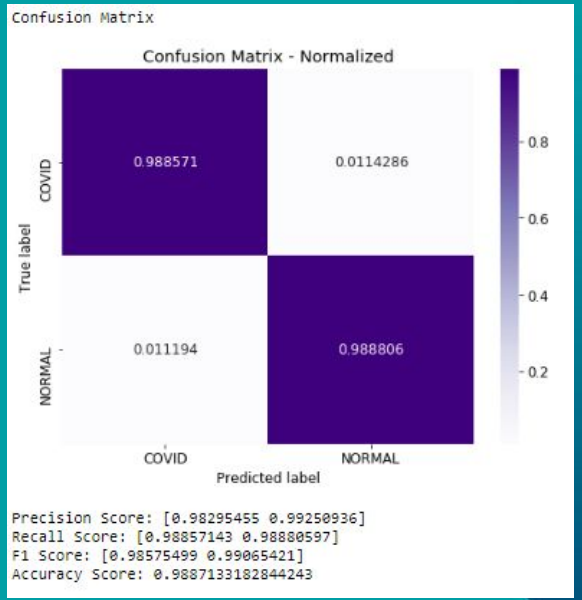
The model loss is 0.03 out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall percentage is 99% and this is the probability of the model diagnosing a correct positive diagnosis out of all the times it diagnosed positive.

Using VGG19 Transfer Learning Model





Results - Covid-19 vs Pneumonia

ACCURACY

The accuracy is 97% and this is the amount of time the predicted result is actually correct.

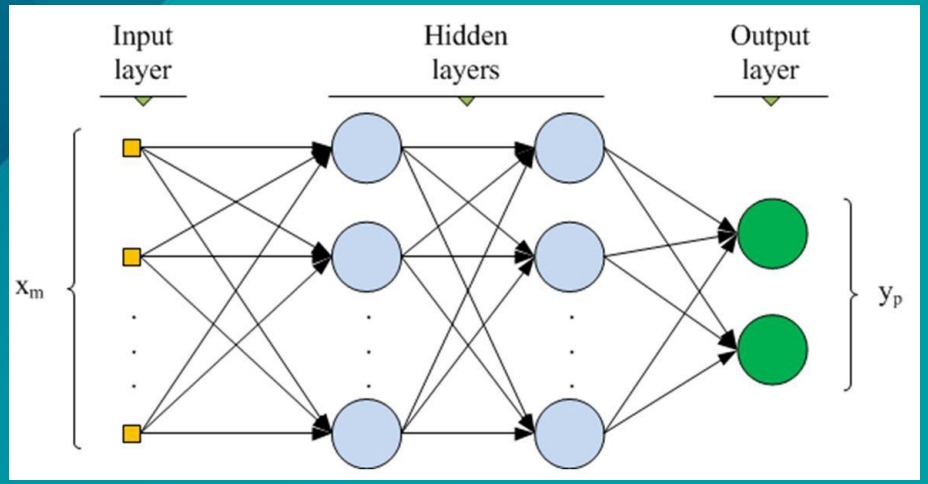
LOG LOSS

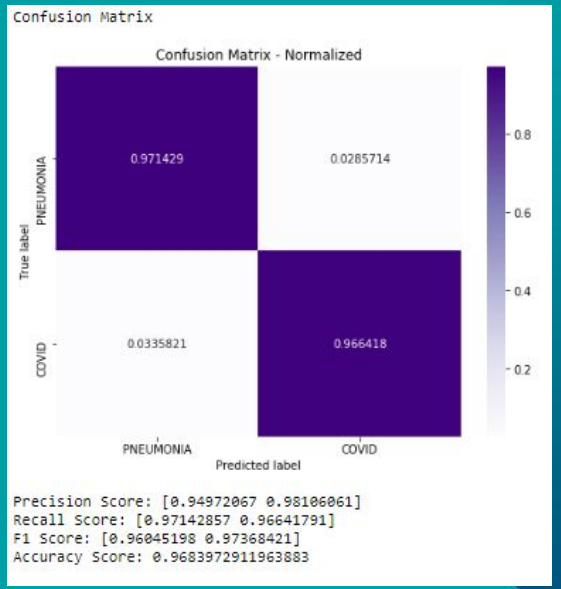
The model loss is 0.11 out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall percentage is 97% and this is the probability of the model diagnosing a correct positive diagnosis out of all the times it diagnosed positive.

Using A Base CNN Model





Results - Covid-19 vs Pneumonia

ACCURACY

The accuracy is 98% and this is the amount of time the predicted result is actually correct.

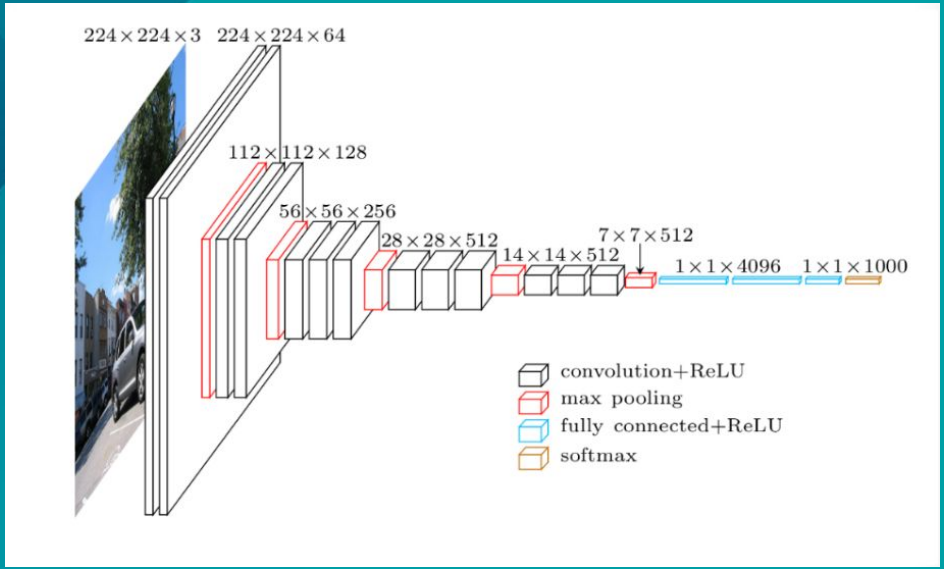
LOG LOSS

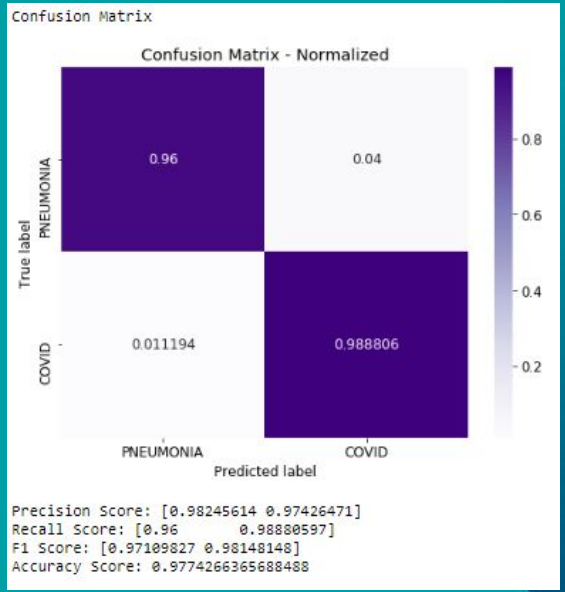
The model loss is 0.07 out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall percentage is 97% and this is the probability of the model diagnosing a correct positive diagnosis out of all the times it diagnosed positive.

Using VGG19 Transfer Learning Model





Conclusion



The Pneumonia model has a recall score of 95%, the covid model has a recall score of 99% and the pneumonia vs covid model has a recall score of 97%. They could be improved by trying different parameters but these scores are good enough as it is so Doctors and Radiologists are more than welcomed to integrate this models into their medical applications to help in the correct diagnosing of lung diseases, after thorough verification.

Recommendation



* Reshape the x-ray sizes to 64 x 64 to reduce the amount of computational time and power consumed when using the VGG19 model.

* Use a Maxpooling layer before flatten the model and using a dense layer of 512 nodes and also a learning rate of 0.0008000000037997961 in order to get a better performing model when using the VGG19 model.

* Add a dropout layer before the final dense layer to dropout half of the output from the prior dense layer using 512 nodes in order to reduce overfitting when using the VGG19 model.

Future Work

Other Lung Diseases

Create a classifier to differentiate pneumonia x-rays from other lung infections like Tuberculosis, etc.

Target Detection

Create a classifier to detect what section of the lungs the infection is located.

Model Improvement

Collect more data and tune more layers to the transfer learning model to improve its performance.

THANK YOU

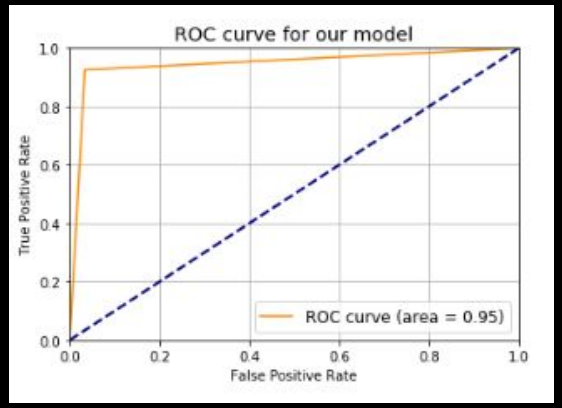
References

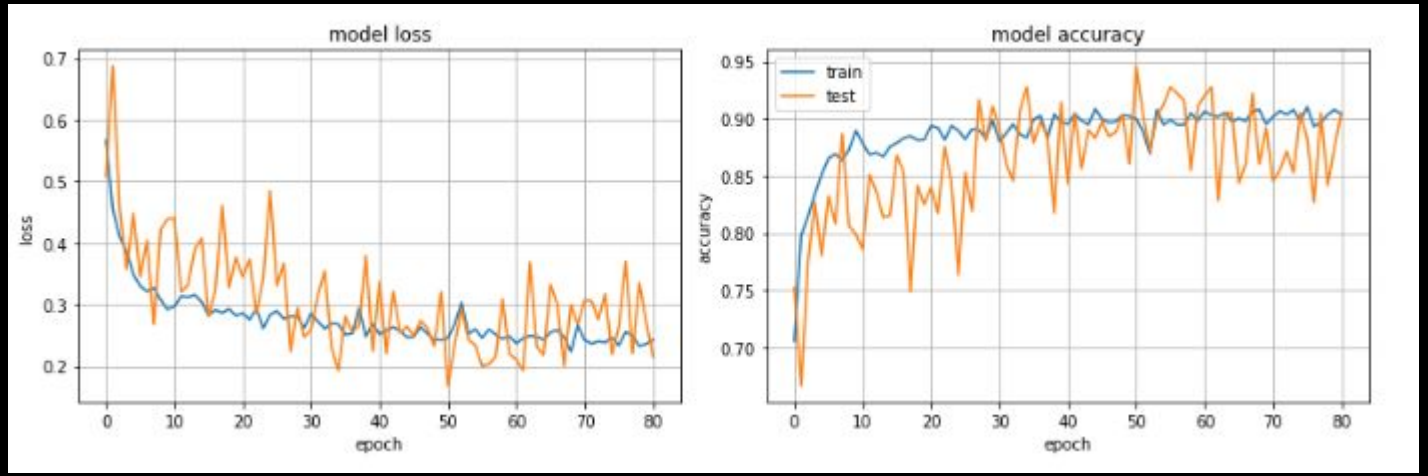
- Misdiagnosis of Pneumonia: Passen & Powell: Chicago Injury Trial Lawyers. (2018, May 08). Retrieved from https://www.passenpowell.com/misdiagnosis-of-pneumonia/
- (n.d.). Retrieved from https://www.nhs.uk/conditions/pneumonia/treatment/
- Gasimov, H. (2019, November 27). Pneumonia Detection from chest radiograph (CXR). Retrieved from https://towardsdatascience.com/pneumonia-detection-from-chest-radiograph-cxr-d02c2fc11609
- towardsdatascience.com/pneumonia-detection-from-chest-radiograph-cxr-d02c2fc11609.
- Ambardekar, N. (2020, June 13). Chemical Pneumonia. Retrieved from https://www.webmd.com/lung/chemical-pneumonia
- Unit8co. (2019, January 28). Unit8.co/amld-workshop-pneumonia. Retrieved from https://github.com/unit8co/amld-workshop-pneumonia/blob/master/3_pneumonia/p2_model.ipynb

Appendix - Pneumonia

- ***The AUC score is 0.95 and this is the average probability that the model can diagnose each X-ray image correctly.***

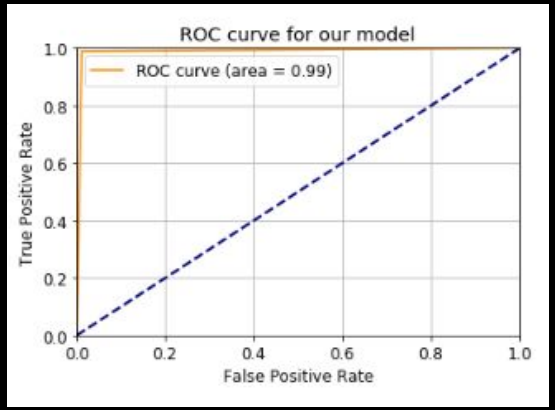
- ***The model loss is 0.17 out and this is the amount the model penalizes for incorrect predictions.***

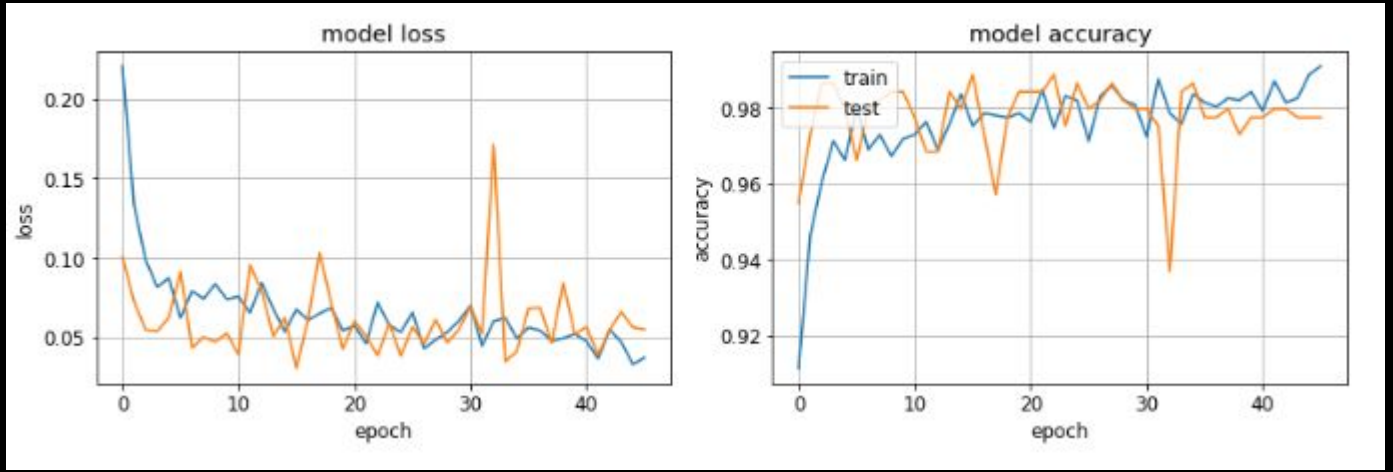




Appendix - Covid-19

- ***The AUC score is 0.99 and this is the average probability that the model can diagnose each X-ray image correctly.***
- ***The model loss is 0.03 out and this is the amount the model penalizes for incorrect predictions.***





Appendix - Covid-19 vs Pneumonia

- ***The AUC score is 0.97 and this is the average probability that the model can diagnose each X-ray image correctly.***

- ***The model loss is 0.07 out and this is the amount the model penalizes for incorrect predictions.***