

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 caused by rushing patients 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

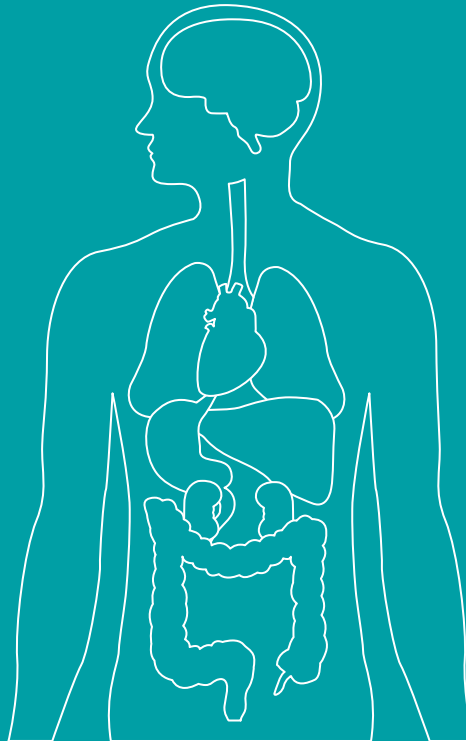
30% 

Temperature should have
reduced.

WEEK 6

70% 

cough and breathlessness should've
reduced.



WEEK 4

 50%

Mucus and chest pain should
have 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

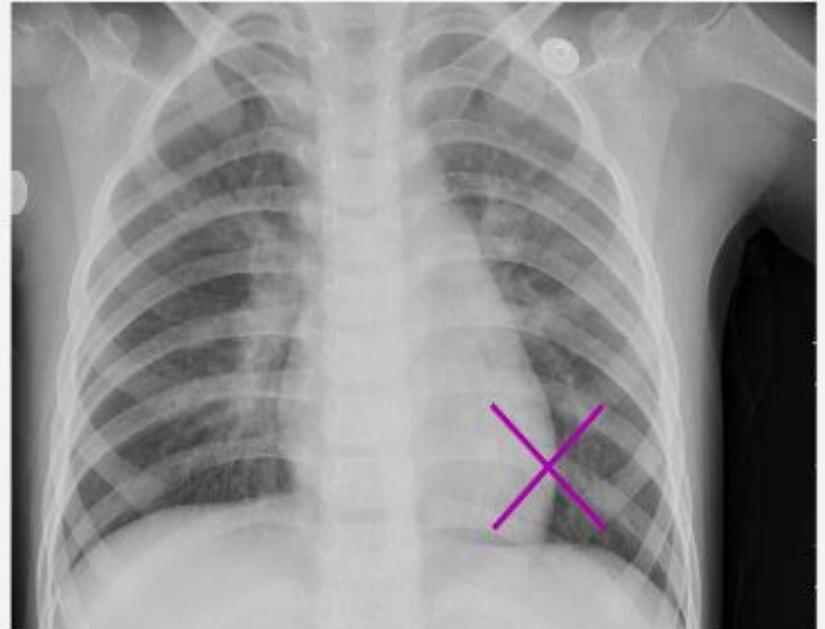
TOTAL: 3,554

Physical Examination

NORMAL



PNEUMONIA



Sequential Model's Results - Pneumonia

ACCURACY

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

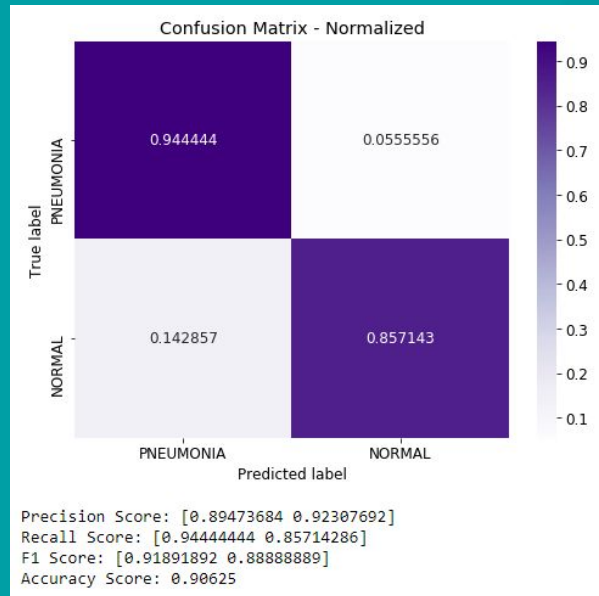
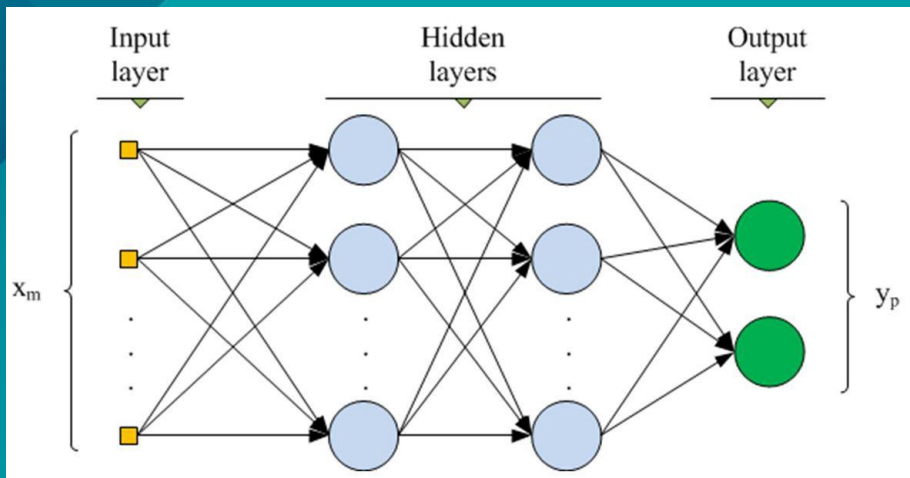
LOG LOSS

The model loss is **0.26** out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall score for pneumonia is **94%** and this is the probability of the model diagnosing a correct positive case out of all the times it diagnosed a positive case.

Using A Base CNN Model



VGG-19 Model's Results - Pneumonia

ACCURACY

The accuracy is 94% and this is the amount of time the predicted result is actually correct.

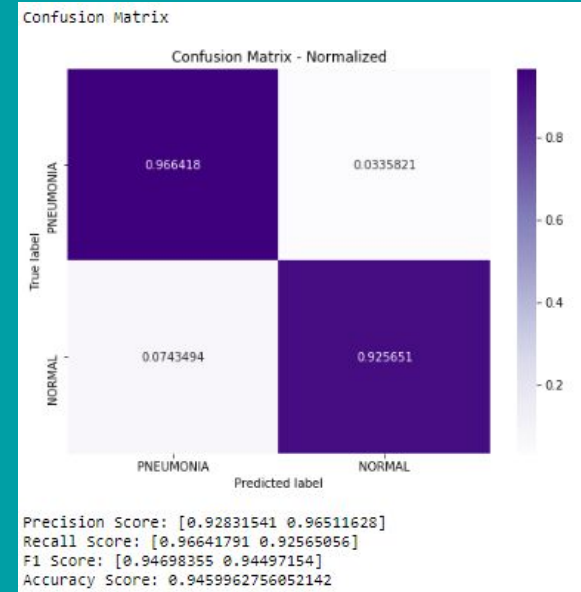
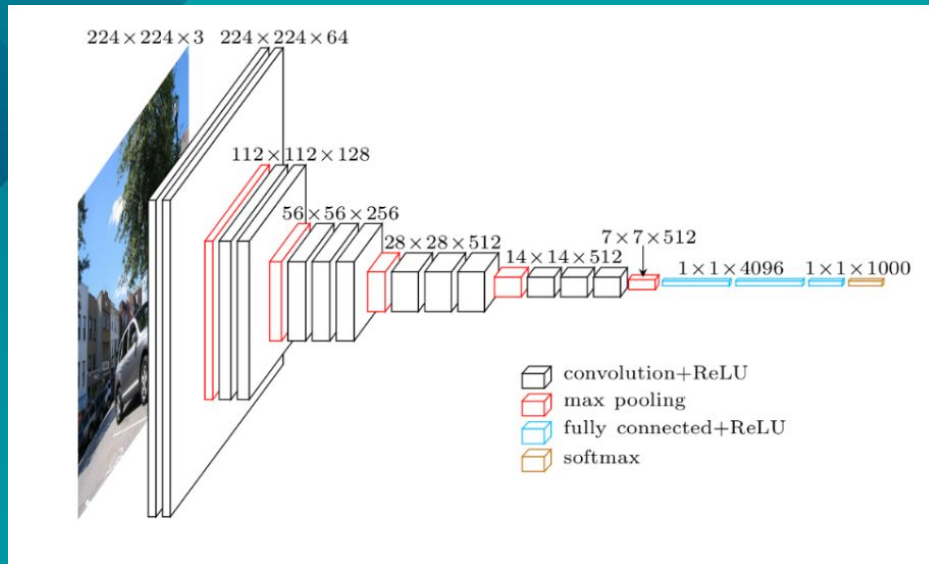
LOG LOSS

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

RECALL

The recall score for pneumonia is 100% and this is the probability of the model diagnosing a correct positive case out of all the times it diagnosed a positive case.

Using VGG19 Transfer Learning Model



Sequential Model's Results - Covid-19

ACCURACY

The accuracy is **88%** and this is the amount of time the predicted result is actually correct.

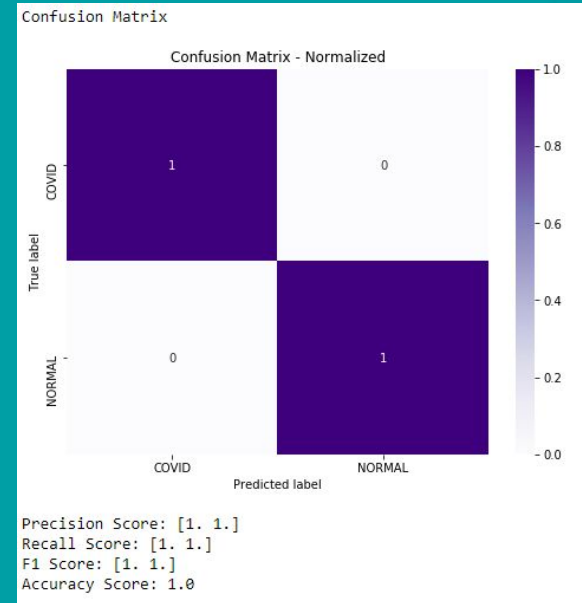
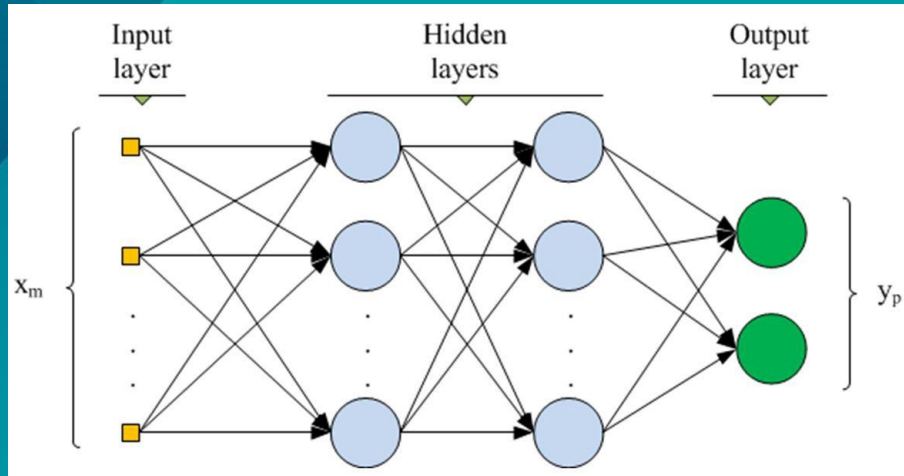
LOG LOSS

The model loss is **0.04** out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall score for Covid-19 is **67%** and this is the probability of the model diagnosing a correct positive case out of all the times it diagnosed a positive case.

Using A Base CNN Model



VGG-19 Model's Results - Covid-19

ACCURACY

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

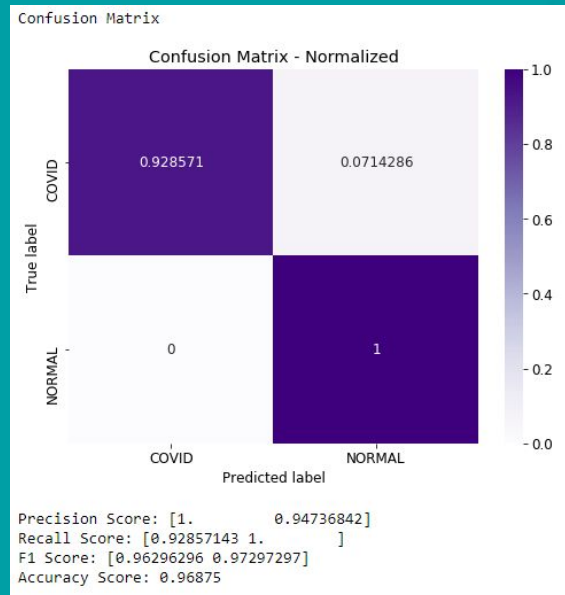
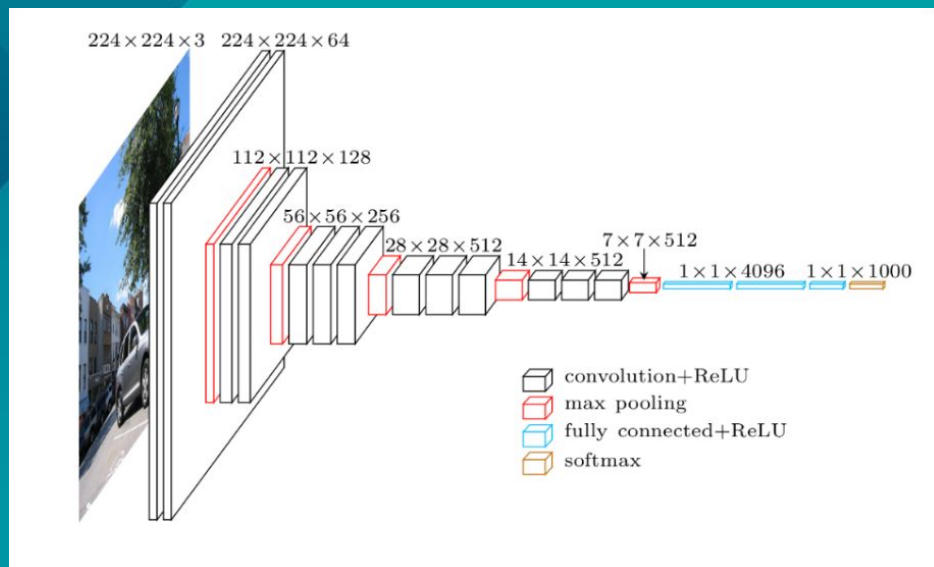
LOG LOSS

The model loss is **0.05** out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall score for Covid-19 is **93%** and this is the probability of the model diagnosing a correct positive case out of all the times it diagnosed a positive case.

Using VGG19 Transfer Learning Model



Sequential Model's Results - Covid-19 vs Pneumonia

ACCURACY

The accuracy is 94% and this is the amount of time the predicted result is actually correct.

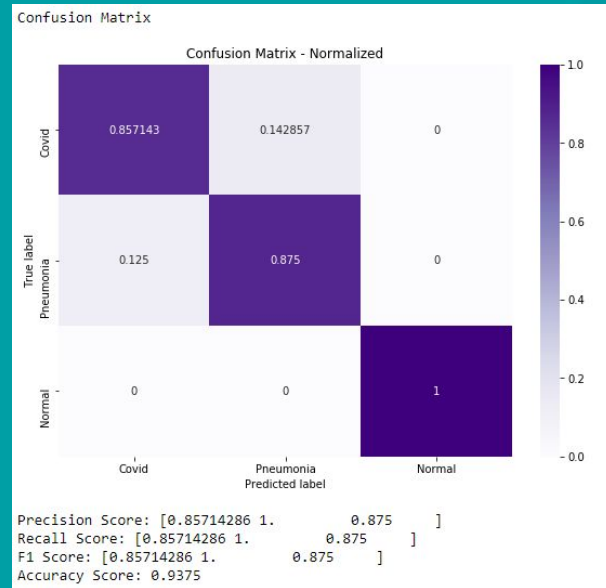
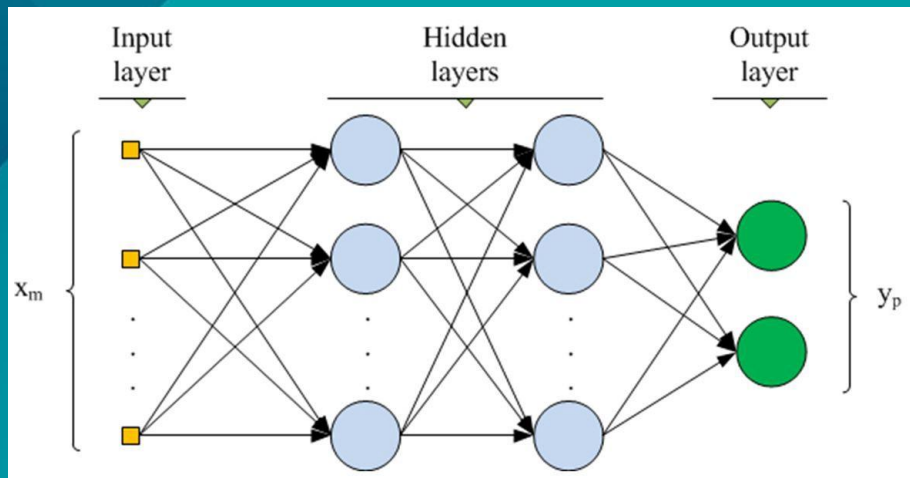
LOG LOSS

The model loss is 0.24 out and this is the amount the model penalizes for incorrect predictions.

RECALL

The recall score for Covid-19 is 86% and this is the probability of the model diagnosing a correct positive case out of all the times it diagnosed a positive case.

Using A Base CNN Model



VGG-19 Model's Results - Covid-19 vs Pneumonia

ACCURACY

The accuracy is 100% and this is the amount of time the predicted result is actually correct.

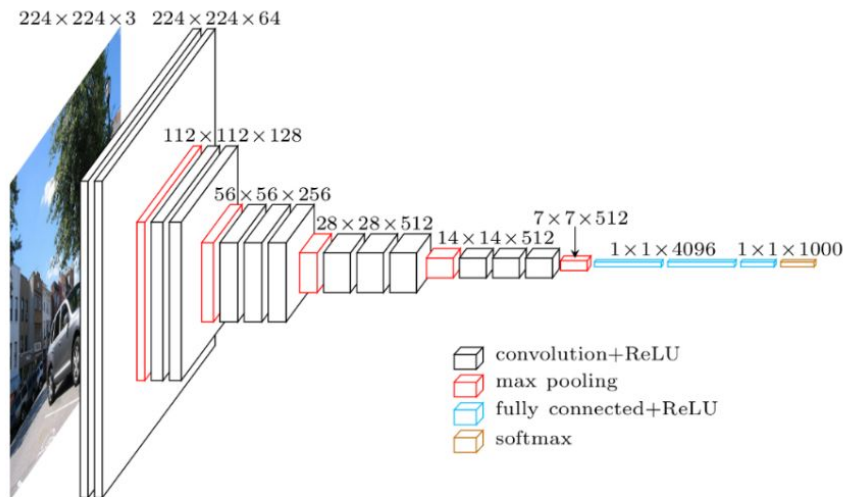
LOG LOSS

The model loss is 0.2 out and this is the amount the model penalizes for incorrect predictions.

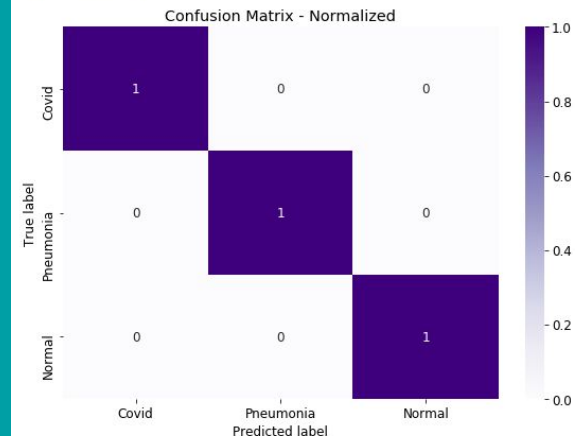
RECALL

The recall score for Covid-19 is 100% and this is the probability of the model diagnosing a correct positive case out of all the times it diagnosed a positive case.

Using VGG19 Transfer Learning Model



Confusion Matrix



Precision Score: [1. 1. 1.]
Recall Score: [1. 1. 1.]
F1 Score: [1. 1. 1.]
Accuracy Score: 1.0

Conclusion



The Pneumonia model has a recall score of 100% for pneumonia, the covid model has a recall score of 93% for covid-19, and the pneumonia vs covid multi-classification model has a recall score of 100% for covid-19. 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



- Use the vgg-19 model since it shows its 26% better at correctly diagnosing a covid case in the binary classification model and 15% better at correctly diagnosing a covid case in the multi-classification 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.



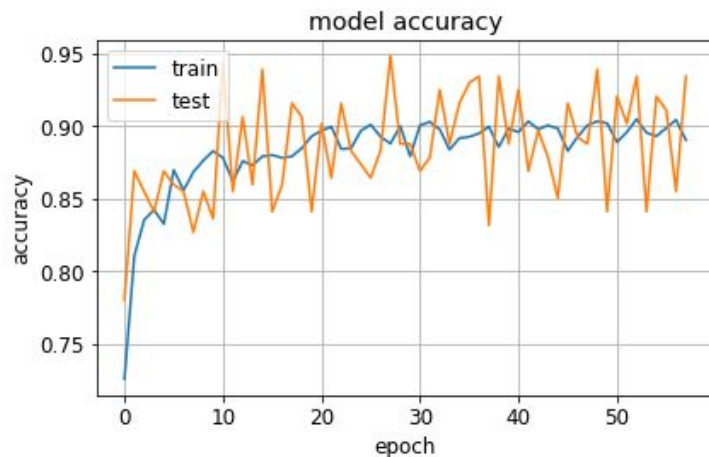
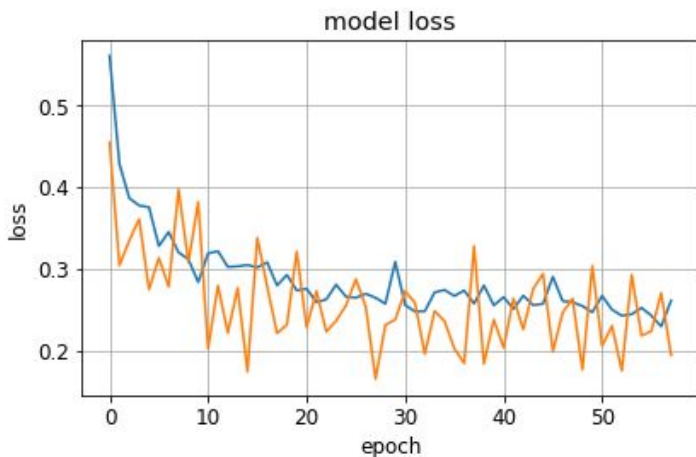
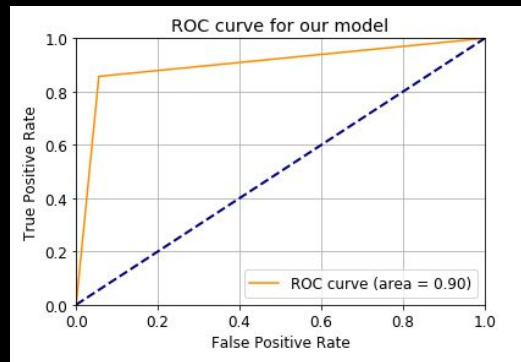
THANK YOU

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

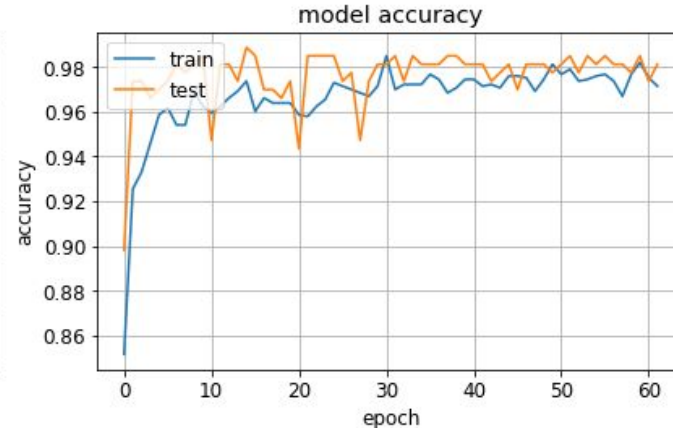
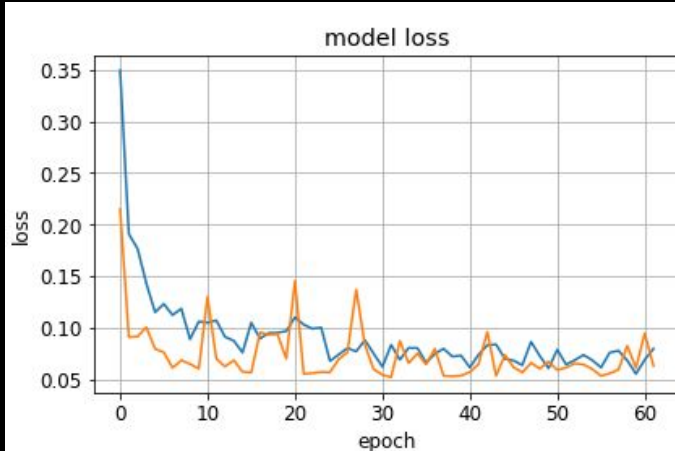
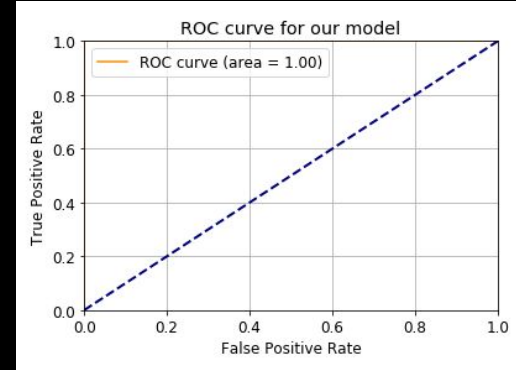
Appendix - Pneumonia

- *The AUC score is 0.90 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 0.100 and this is the average probability that the model can diagnose each X-ray image correctly.*
- *The model loss is 0.05 out and this is the amount the model penalizes for incorrect predictions.*



Appendix - Covid-19 vs Pneumonia

- *The AUC score is 0.93 and this is the average probability that the model can diagnose each X-ray image correctly.*
- *The model loss is 0.02 out and this is the amount the model penalizes for incorrect predictions.*

