



# Queensland University of Technology

## PREDICTING COVID-19 STATUS FROM CHEST X-RAY IMAGES

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### **IFN 646 – BIOMEDICAL DATA SCIENCE**

#### **PREPARED BY**

Nhung Nguyen – 10655549

An Ngo – 10324399

Long Ngan Nguyen – 9786198

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Lecturer: Dr Dimitri Perrin

## I. INTRODUCTION

From December 2019, there was a virus known as “2019 novel corona-virus” or “Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)” that has been identified from Wuhan, China and its infectious disease is called COVID-19. Until 14<sup>th</sup> October 2020, more than 37.7 billion confirmed cases have been results in 235 countries, areas and territories according to announcement of WHO (2020). Currently, early symptom diagnosing is highly importance to self-isolate the suspected people and decrease the risk of spreading to public community’s health due to lack of specific treatment or vaccine for this virus.

In many countries, to detect suspected COVID-19 individuals, governments have applied reverse transcriptase–polymerase chain reaction (RT-PCR) or collecting pharyngeal swabs or blood specimens to detect people who is suspected as positive with COVID-19 (Wang et al., 2020). According to Department of Heath of Australia Government (2020), it may take 1 or 2 days to get the results of PCR and while people is waiting for their testing result, they need to perform self-isolation at home. Compared to chest radiography, X-Ray imaging is a method which is easy to apply and fast diagnosis for pneumonia. In the research of Kanne et al. (2020), the author reported that radiography images are able to visualize the correlation with COVID-19. The symptoms of COVID-19 are reported to be as following, ground-glass (57%) and mixed attenuation (29%) (Kong and Agarwal as cited in Minaee et al., 2020), the pulmonary vessels are edged by ground glass pattern make it becomes more difficult to appreciate visually reported in the research of Feng et al. (2016). In addition, Asymmetric patchy or diffuse airspace opacities are also reported for COVID-19 (Rodrigues et al., 2020). These abnormalities are only be observed by expert radiologists. However, the ratio between trained radiologists and suspected cases is imbalance and with the number of suspected cases continues to increase, an automatic method for identification of such subtle abnormalities to assist with diagnosis is crucial. Therefore, Artificial Intelligence (AI) solutions are promising methods which are significant for solving such problems.

The pandemic that caused by COVID-19 has raised an alarm to the way people react to diseases and viruses. Although machine learning was applied to support medical image classification, this traditional approach was not powerful enough to win against the race of detecting COVID-19 amid the escalation of the epidemic. Thus, instead of following a two-step procedure including feature extraction and recognition, we use an end-to-end deep learning framework. The approach will directly predict the COVID-19 based on raw X-Ray images of lungs without requiring feature extraction. Deep learning model, or more specifically Convolutional Neural Networks (CNN) have been proved that outstrip traditional AI approaches in the field of computer vision in recent years, and have been applied widely to solve various problems, such as classification, segmentation, face recognition, to super-resolution and image enhancement (Bhosle et al., 2018; Li et al., 2018).

Additionally, we adopt the approach of training traditional Convolutional Neural Network on COVID-19 dataset of Wang et al. (2020), and evaluate the performance of models on predicting

COVID-19 detection. However, since the medical images of COVID-19 are not widely published, there is a limited number of available publicity images. Thus, in order to improve and measure the performance of COVID-19 detection experiment, we apply 2 following strategies:

- We apply different techniques to transform the images in the effort of data augmentation, such as flipping and small rotation, to increase the number of samples.
- We also calculate the confidence interval of the performance metrics on the respective models. In addition, we provide Area Under the Curve (AUC) to summarize the performance of models in our report.

The data availability including codes and dataset are now published on Git ([https://github.com/ifn-646/x\\_ray\\_project](https://github.com/ifn-646/x_ray_project))

## II. COVID-19 X-ray DATASET

The COVID-19 X-ray dataset consists of chest X-rays from two datasets: Covid-19 Radiography Dataset which contains a total of 219 Covid-19 Positive images and 1341 Covid-19 Negative test images are separated in two labelled folders. Another dataset is the Covid-Chest Xray-Dataset, which was recently published and is comprised of a set of images from published sources regarding COVID-19 topics collected by <https://github.com/ieee8023/covid-chestxray-dataset>, Cohen et al. (2020). This dataset is compiled of a blend of CT images along with chest X-rays.

***(Metadata) visualization figure shows that CT Scan was 14%). (need to insert figure)***

This pool of data is unceasingly updated, and meta-data such as age, findings, sex, survival and hospitalization status are also recorded. Part of the COVID-19 images used for this project contains the images that derived from this dataset. We have only kept the PA view images for COVID-19 prediction.

The resolution should be mentioned regarding this dataset, as it varies widely. The lower-resolution COVID-19 images are below 400 x 400, while some of the higher ones are exceeding 1900 x 1400. The models produce accurate results regardless of this disparity in image quality. Although exceptional image quality should be strived for, it is a focus in the machine learning realm to create systems that are able to operate well regardless of differing image qualities. The dynamic ranges also differ as they are images collected from various providers. These images are indeed normalized to decrease model confusion.

## III. PROPOSED FRAMEWORK

**To be updated.**



## REFERENCES

- Bhosle, V., Supriya, S., Sowmya, M., Subramani, V., & Shruthi, G. (2018). Face Recognition with 2D-Convolutional Neural Network. *International Journal of Advanced Research in Computer Science*, 9(Special Issue 3), 373-377. <https://doi.org/10.26483/ijarcs.v9i0.6271>
- Feng, Z.-M., Zhuang, Z.-J., He, W.-B., Ding, J.-P., Yang, W.-J., & Chen, X.-Y. (2016). Lung Cancer with Diffuse Ground-glass Shadow in Two Lungs and Respiratory Failure. *Chinese Medical Journal*, 129(15). <https://doi.org/10.4103/0366-6999.186632>
- Department of Health of Australia Government. (2020). *What you need to know about coronavirus (COVID-19)*. <https://www.health.gov.au/news/health-alerts/novel-coronavirus-2019-ncov-health-alert/what-you-need-to-know-about-coronavirus-covid-19>
- Kanne, J. P., Little, B. P., Chung, J. H., Elicker, B. M., & Ketai, L. H. (2020). Essentials for Radiologists on COVID-19: An Update- Scientific Expert Panel. *Radiology*, 296(2), E113. <https://doi.org/10.1148/radiol.2020200527>
- Li, C., Guo, J., Porikli, F., & Pang, Y. (2018). LightenNet: A Convolutional Neural Network for weakly illuminated image enhancement. *Pattern recognition letters*, 104, 15-22. <https://doi.org/10.1016/j.patrec.2018.01.010>
- Li, H., Jiang, G., Zhang, J., Wang, R., Wang, Z., Zheng, W.-S., & Menze, B. (2018). Fully convolutional network ensembles for white matter hyperintensities segmentation in MR images. *NeuroImage (Orlando, Fla.)*, 183, 650-665. <https://doi.org/10.1016/j.neuroimage.2018.07.005>
- Minaee, S., Kafieh, R., Sonka, M., Yazdani, S., & Jamalipour Soufi, G. (2020). Deep-COVID: Predicting COVID-19 from chest X-ray images using deep transfer learning. *Medical image analysis*, 65. <https://doi.org/10.1016/j.media.2020.101794>
- Rodrigues, J. C. L., Hare, S. S., Edey, A., Devaraj, A., Jacob, J., Johnstone, A., McStay, R., Nair, A., & Robinson, G. (2020). An update on COVID-19 for the radiologist - A British society of Thoracic Imaging statement. *Clinical radiology*, 75(5), 323-325. <https://doi.org/10.1016/j.crad.2020.03.003>
- Wang, L., & Wong, A. (2020). COVID-Net: A Tailored Deep Convolutional Neural Network Design for Detection of COVID-19 Cases from Chest X-Ray Images. *arXiv.org*.

Wang, W., Xu, Y., Gao, R., Lu, R., Han, K., Wu, G., & Tan, W. (2020). Detection of SARS-CoV-2 in Different Types of Clinical Specimens. *JAMA : the journal of the American Medical Association*, 323(18), 1843-1844. <https://doi.org/10.1001/jama.2020.3786>

WHO. (2020). *Coronavirus disease (COVID-19) pandemic*.  
<https://www.who.int/emergencies/diseases/novel-coronavirus-2019>