Deep Learning prediction of COVID-19

Muhamad Tahir

GA Meeting 04/19/2021

Content:

- Image detection: Introduction
- Problem Statement
- Objectives
- Models prediction: NN, early stopping, dropout, regularization
- Interpretation: SHAP
- Images VS Text: NLP Analysis
- Summary and Outlook

Image detection: Introduction

nature machine intelligence

ANALYSIS

https://doi.org/10.1038/s42256-021-00307-0

Check for updates

OPEN

Common pitfalls and recommendations for using machine learning to detect and prognosticate for COVID-19 using chest radiographs and CT scans

Michael Roberts[1,2]✉, Derek Driggs[1], Matthew Thorpe[3], Julian Gilbey[1], Michael Yeung[4], Stephan Ursprung[4,5], Angelica I. Aviles-Rivero[1], Christian Etmann[1], Cathal McCague[4,5], Lucian Beer[4], Jonathan R. Weir-McCall[4,6], Zhongzhao Teng[4], Effrossyni Gkrania-Klotsas[7], AIX-COVNET*, James H. F. Rudd[8,36], Evis Sala[4,5,36] and Carola-Bibiane Schönlieb[1,36]

Machine learning methods offer great promise for fast and accurate detection and prognostication of coronavirus disease 2019 (COVID-19) from standard-of-care chest radiographs (CXR) and chest computed tomography (CT) images. Many articles have been published in 2020 describing new machine learning-based models for both of these tasks, but it is unclear which are of potential clinical utility. In this systematic review, we consider all published papers and preprints, for the period from 1 January 2020 to 3 October 2020, which describe new machine learning models for the diagnosis or prognosis of COVID-19 from CXR or CT images. All manuscripts uploaded to bioRxiv, medRxiv and arXiv along with all entries in EMBASE and MEDLINE in this timeframe are considered. Our search identified 2,212 studies, of which 415 were included after initial screening and, after quality screening, 62 studies were included in this systematic review. Our review finds that none of the models identified are of potential clinical use due to methodological flaws and/or underlying biases. This is a major weakness, given the urgency with which validated COVID-19 models are needed. To address this, we give many recommendations which, if followed, will solve these issues and lead to higher-quality model development and well-documented manuscripts.

Problem Statement

Studies were hampered by issues with poor quality data, poor application of machine learning methodology, poor reproducibility, and biases in study design.

A lot of the machine learning models were trained on sample datasets that were too small to be effective.

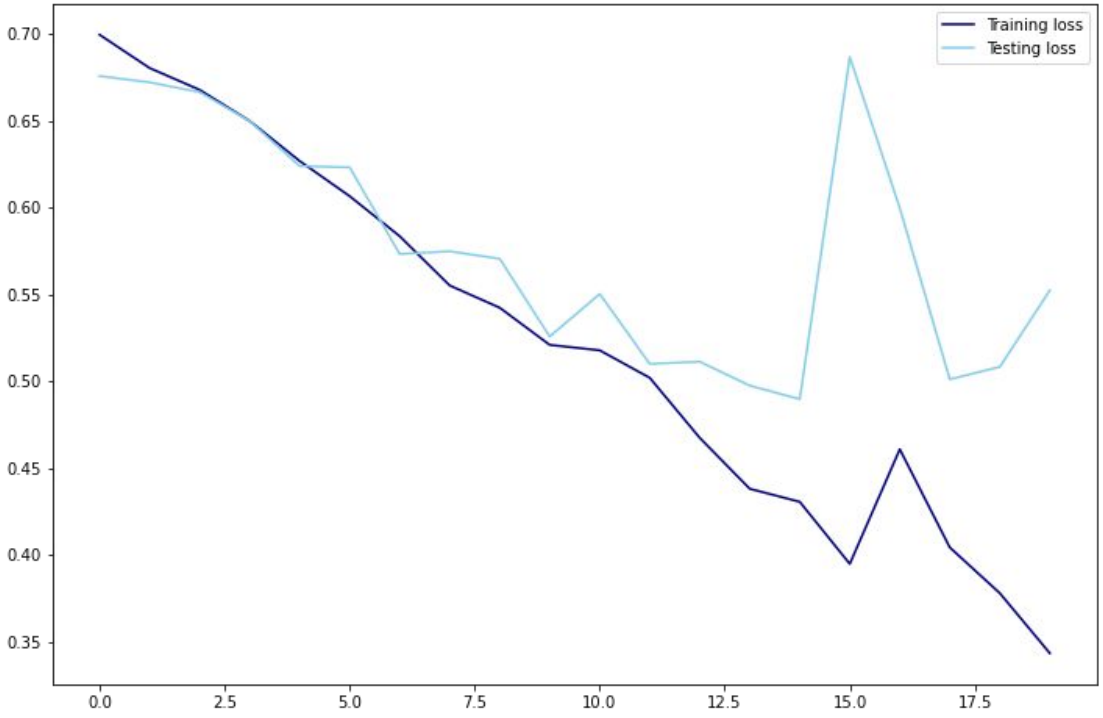
Many other papers, the studies did not specify where their data had come from, or the models were trained and tested on the same data, or they were based on publicly available ‘Frankenstein datasets’ that had evolved and merged over time, making it impossible to reproduce the initial results.

Therefore, in addition to higher quality datasets, manuscripts with sufficient documentation to be reproducible and external validation are required to increase the likelihood of models being taken forward and integrated into future clinical trials to establish independent technical and clinical validation as well as cost-effectiveness.

Objectives

- Explore x-ray Image Data
- Data cleaned and analyzed
- Grid search for best parameters
- Deep Learning Models Employed including NLP
- Interpretation of CNN by SHAP
- Reliable & improved prediction using x-ray images
- Help Physicians to make fast decision to stop spread

Convolutional Neural Network (CNN)



	precision	recall	f1-score	support
0	0.79	0.58	0.67	45
1	0.74	0.89	0.81	62
accuracy			0.76	107

Removed CT scans

Front and side images used

Grid search for best parameters

Repeated images used

Interpretation

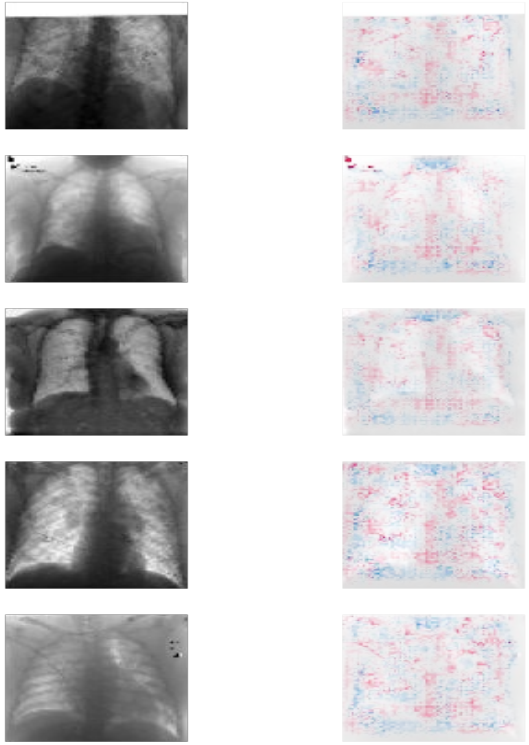
X-ray are damaged, repeated, more than one sided etc

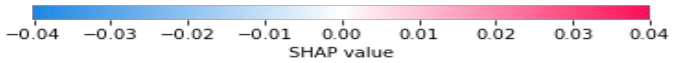
Damaged images; see top left corner

Red means COVID is positive

Blue means COVID is negative

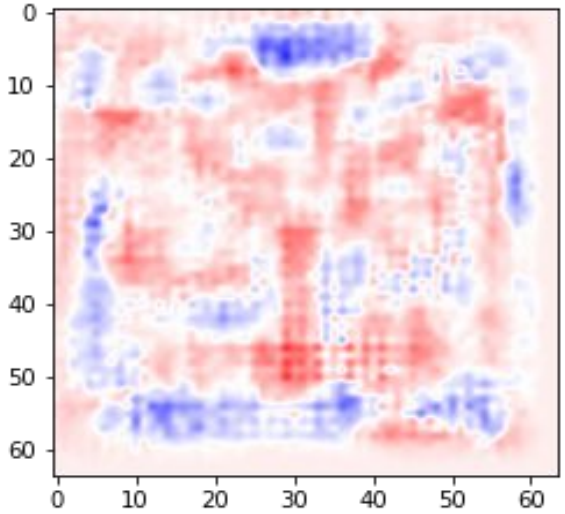
Red regions confirm damage of lungs

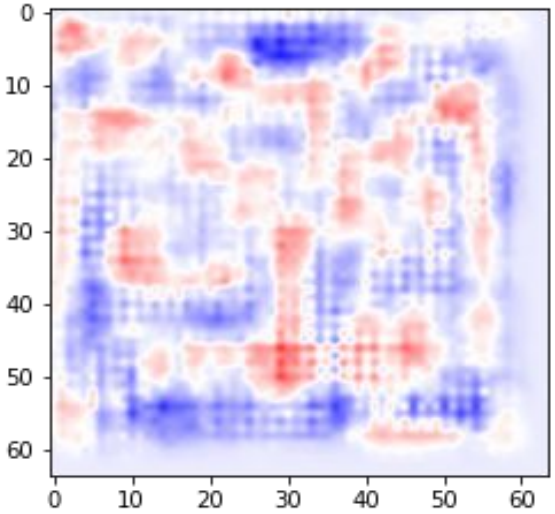




Interpretation

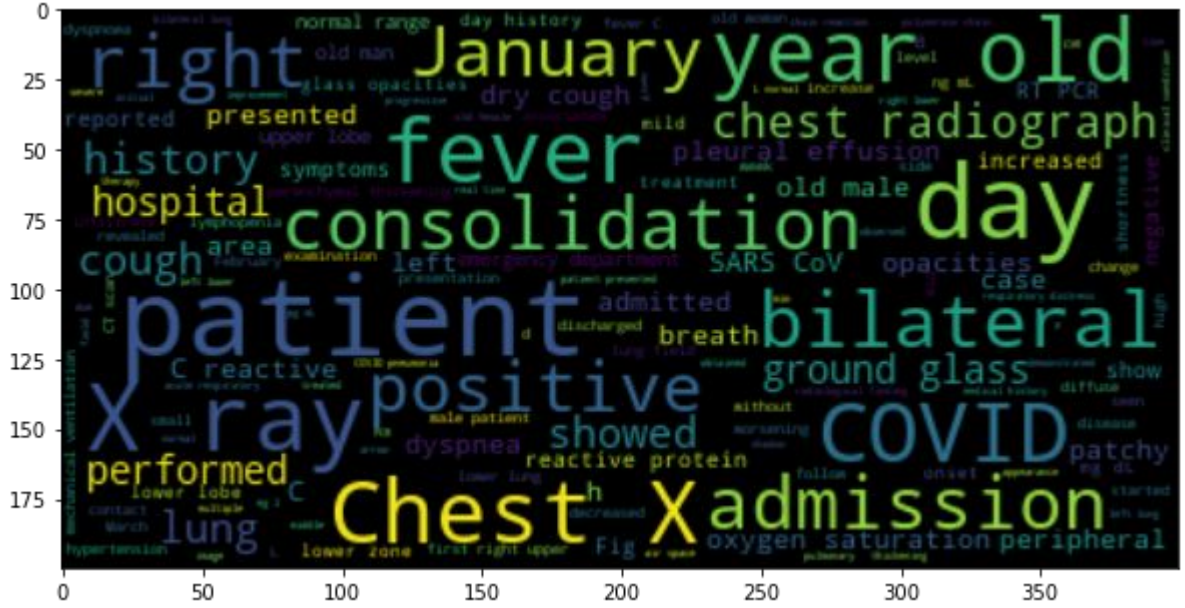
CNN is better than other methods like early stopping, dropout layers or regularization





Positive and Negative

NLP Analysis: word cloud



More bigger are most repeated words and then plan to remove most obvious words

NLP Analysis: score

Removed most obvious like covid and sars

Better score than image prediction

	precision	recall	f1-score	support
0	0.92	0.85	0.88	39
1	0.88	0.94	0.91	47
accuracy			0.90	86

Unique patient ID is important; for each patient we have more than one data

Unique images are worth looking and using single type like x-ray or ct-scan or side images

Summary & Outlook

- CNN score: 0.76
- NLP score much improved: 0.90
- Other methods like; integrated-gradients or Saliency maps
- Clean, Large and more reliable data needed
- Combined new model for reliable large datasets