Deep Features for the Evidence of Covid-19 Screening Using Chest X-rays

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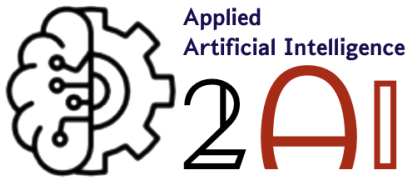


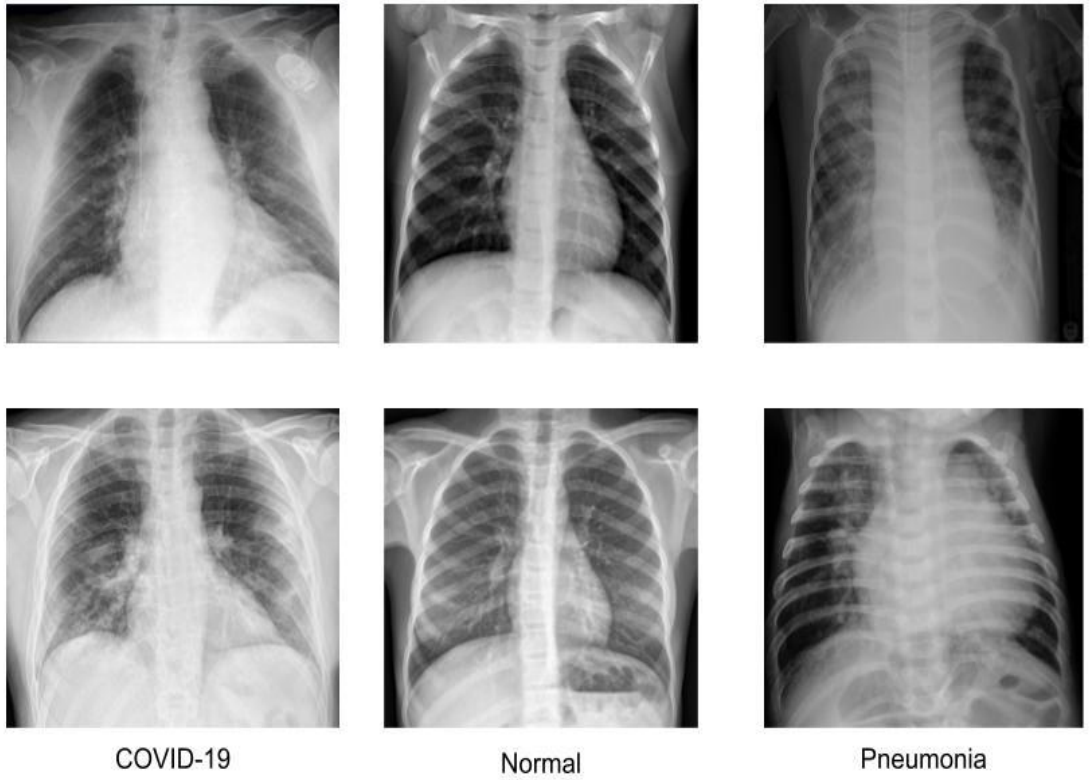
Overview

Chest X-ray images could facilitate greatly in mass Covid-19 screening.

In this study, we build deep learning models to detect Covid-19 positive cases using chest X-ray image.

We leverage DNN models such as CheXNet, DenseNet, ResNet, VGG to build automated Covid-19 screening.

Early results (based on deep features) show performance improvement and further possibilities.



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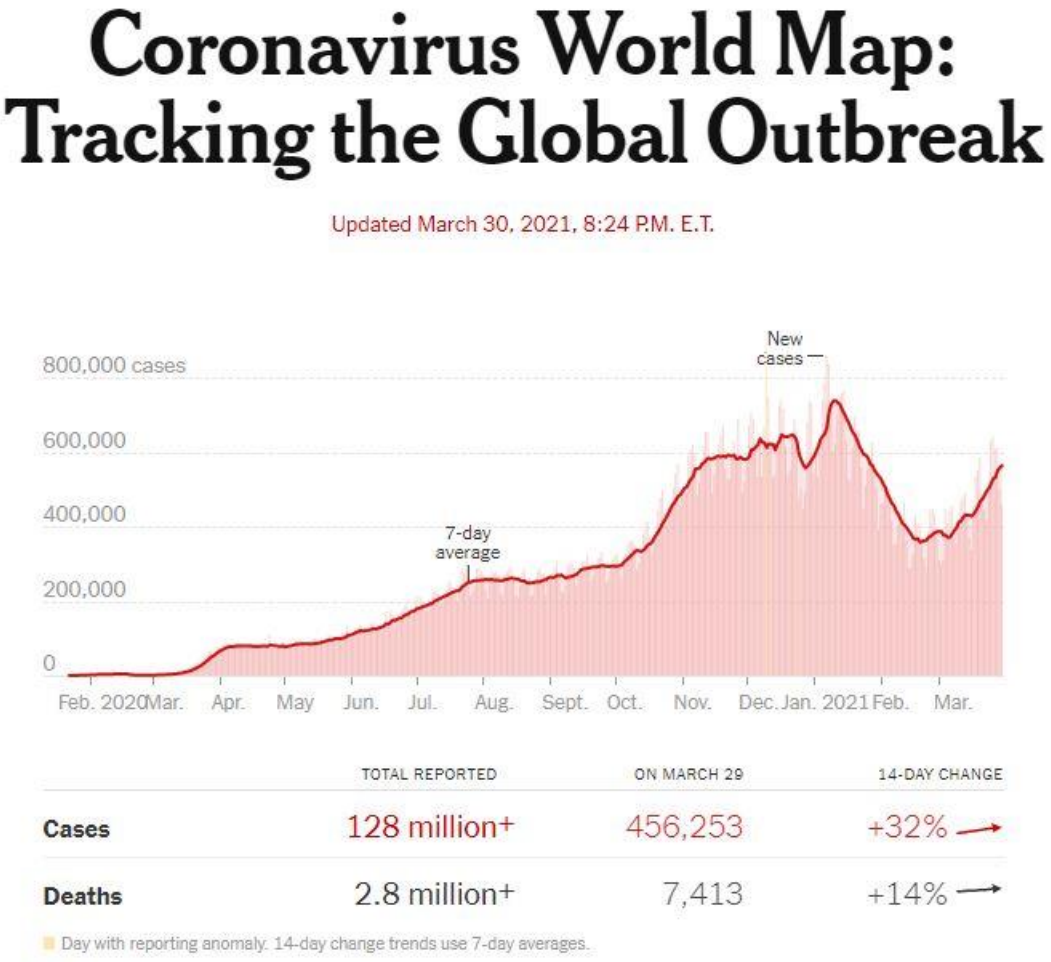
Motivation

- Since December 2019, the infection rate of Covid-19 cases has been very high.
- In such infectious disease, early detection tools would help largely to mitigate the spread and save lives.
- Current Covid-19 screening are expensive and time-consuming.
- Chest X-ray imaging is available and accessible in many clinical sites as it is considered standard equipment in most healthcare systems.



Related Work

- A number of AI-driven tools have been used to help predict, screen, and diagnose Covid-19 positive cases.
  - Santosh, K.C. AI-Driven Tools for Coronavirus Outbreak: Need of Active Learning and Cross-Population Train/Test. Models on Multimudinal/Multimodal Data. J Med Syst 44, 94 (2020). https://doi.org/10.1007/s10916-020-01562-1

- A Convolutional Neural Network (CNN) –tailored Deep Neural Network (DNN) has been proposed that can collectively train/test both CT scans and Chest X-rays.
  - Mukherjee, H., Ghosh, S., Dhar, A., Santosh, K.C. et al. Deep neural network to detect Covid-19: one architecture for both CT Scans and Chest X-rays. Appl Intell (2020). https://doi.org/10.1007/s10489-020-01943-6

- However, the performance was not up to the mark because at that time there were not available data. Now we are using state-of-the art for better performance.

Data Collection

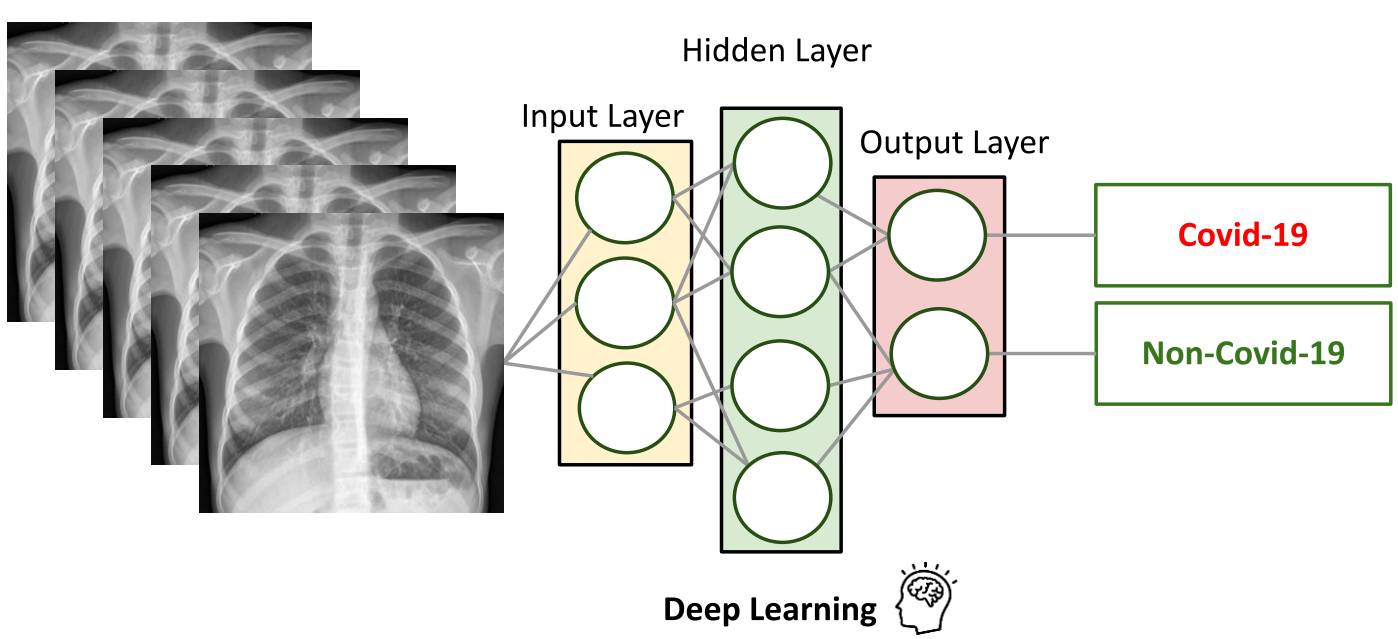
- We have collected 8,214 Chest X-Ray images from 4 different sources.

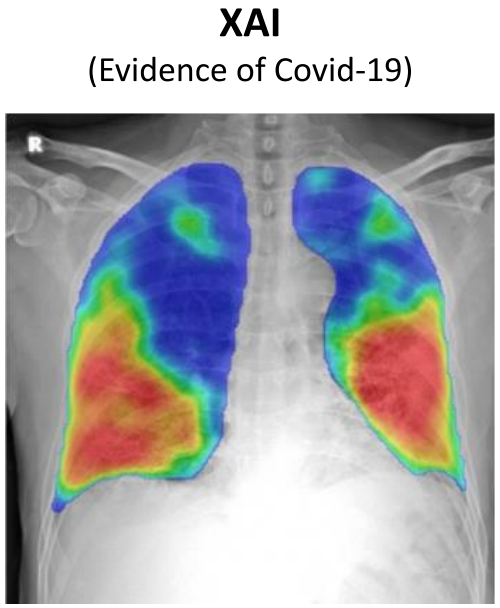
- Balanced Dataset for Experiment: 4,716 CXRs (2,358 Covid-19 positive & 2,358 non-Covid-19 (Healthy: 1,583 + Pneumonia: 775)

Chest X-Ray Image	Collections
Healthy Chest X-Ray	1,583
Pneumonia Chest X-Ray	4,273
Covid-19 Chest X-Ray	2,358
Total Chest X-Ray	**8,214**

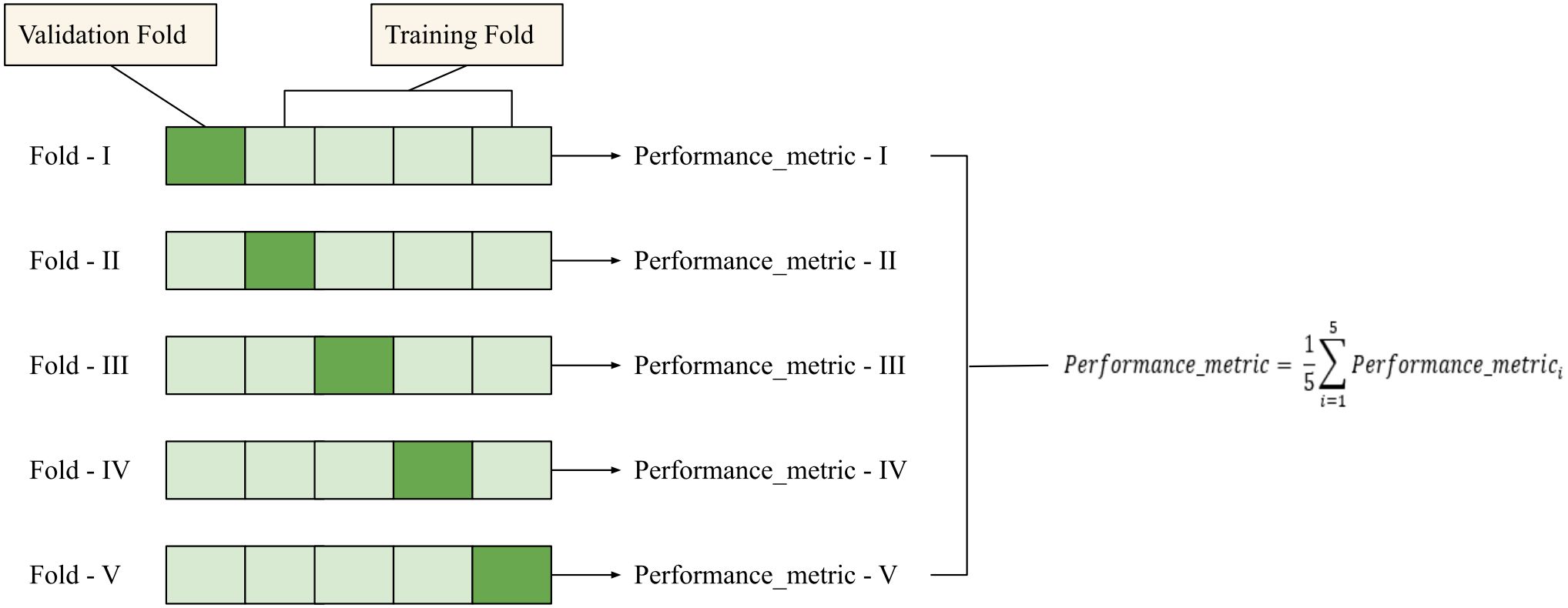
Methodology

- The schematic view of the Deep learning models that we followed





Training



- Schematic representation of cross validation
- We are using k-fold cross validation to make model more robust.

Results

μ ± σ	AUC	ACC	SPEC	SEN
CheXNet	0.99 ± 0.008	98.45 ± 0.011	0.98 ± 0.013	0.99 ± 0.007
DenseNet169	0.98 ± 0.005	98.13 ± 0.008	0.99 ± 0.008	0.98 ± 0.008
ResNet50	0.59 ± 0.022	59.18 ± 0.020	0.59 ± 0.022	0.59 ± 0.022
VggNet16	0.59 ± 0.024	58.92 ± 0.025	0.59 ± 0.024	0.59 ± 0.024

Comparison: AUC, ACC (in %), SPEC, and SEN of CheXNet, DenseNet169, ResNet50 and VggNet16 (Covid-19 vs Non-Covid-19)

Conclusion

Chest X-ray imaging enables rapid screening of patients to suspect of Covid-19 virus.

Because of Chest X-ray's availability and accessibility, early detection is possible to reduce the infection rate, specially in mass populated area.

Chest X-ray images of Covid-19 patients could compare with other abnormalities like Pneumonia, Tuberculosis, Lung Cancer, etc.

Future Work

- Based on the results, we would improve the model architecture to explore more features.
- We would be able to use our model in consumption with other models that work on diseases like Pneumonia, Tuberculosis x-ray images.
- The model would be deployed in real world scenarios for screening and prediction.

References

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Thank you