Detecting COVID-19 in Airport Traffic with Deep Learning

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Problem Statement

March 7, 2020

April 7, 2020

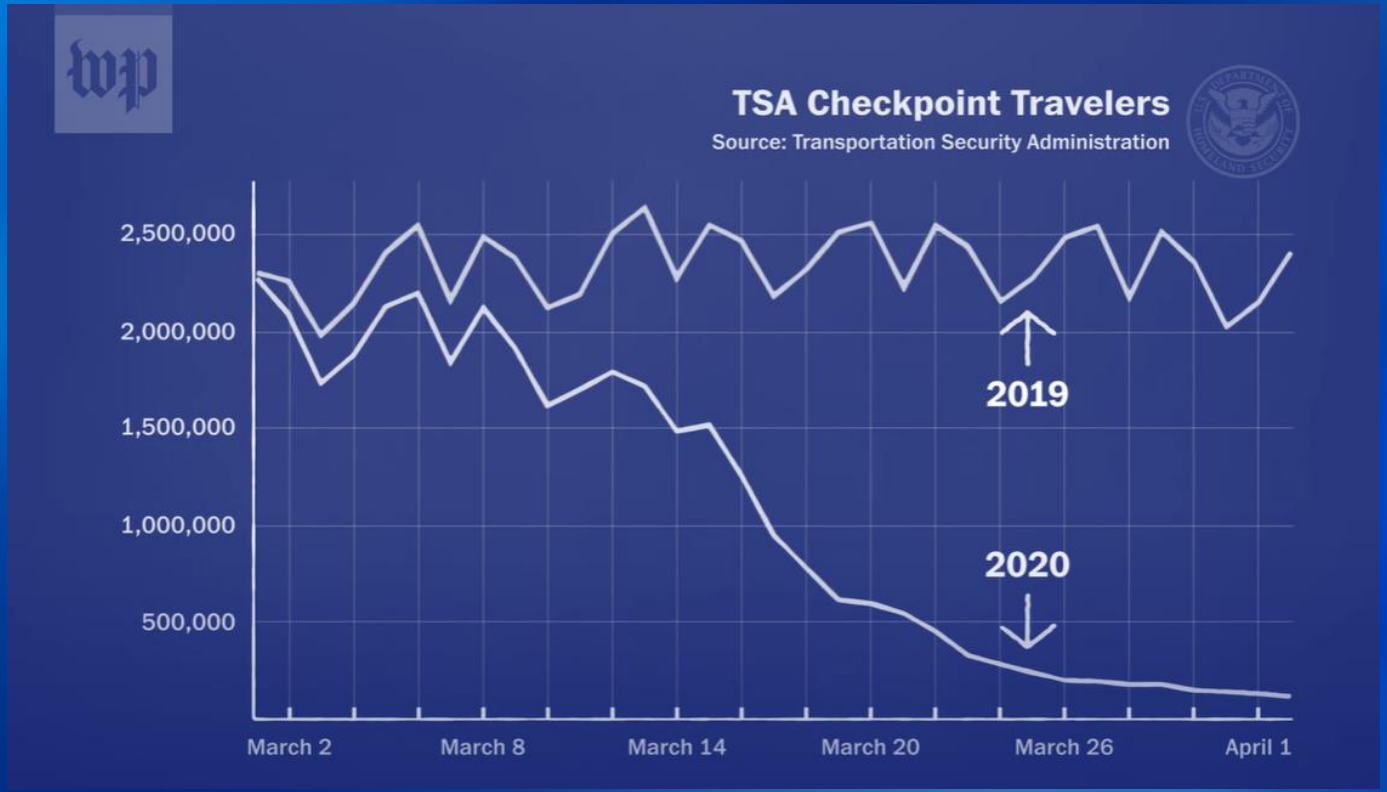
15,012 Flights

5,275 Flights

IATA COVID-19 FINANCIAL IMPACT

MARKET	IMPACT ON PASSENGER NUMBERS	IMPACT ON PASSENGER REVENUES
Australia, China, Japan, Malaysia, Singapore, South Korea, Thailand, Vietnam	-23%	-$49.7 billion
Austria, France, Italy, Germany, Netherlands, Norway, Spain, Switzerland, Sweden, the United Kingdom	-24%	-$37.3 billion
Rest of Europe	-9%	-$6.6 billion
Bahrain, Iraq, Iran, Kuwait, Lebanon, the United Arab Emirates	-23%	-$4.9 billion
Rest of Middle East	-9%	-$2.3 billion
Canada and US	-10%	-$21.1 billion

Problem Statement



Proposal pt.1

Arrival

Risk assessment upon arrival at airport through contact tracing & temperature checks.

At Risk

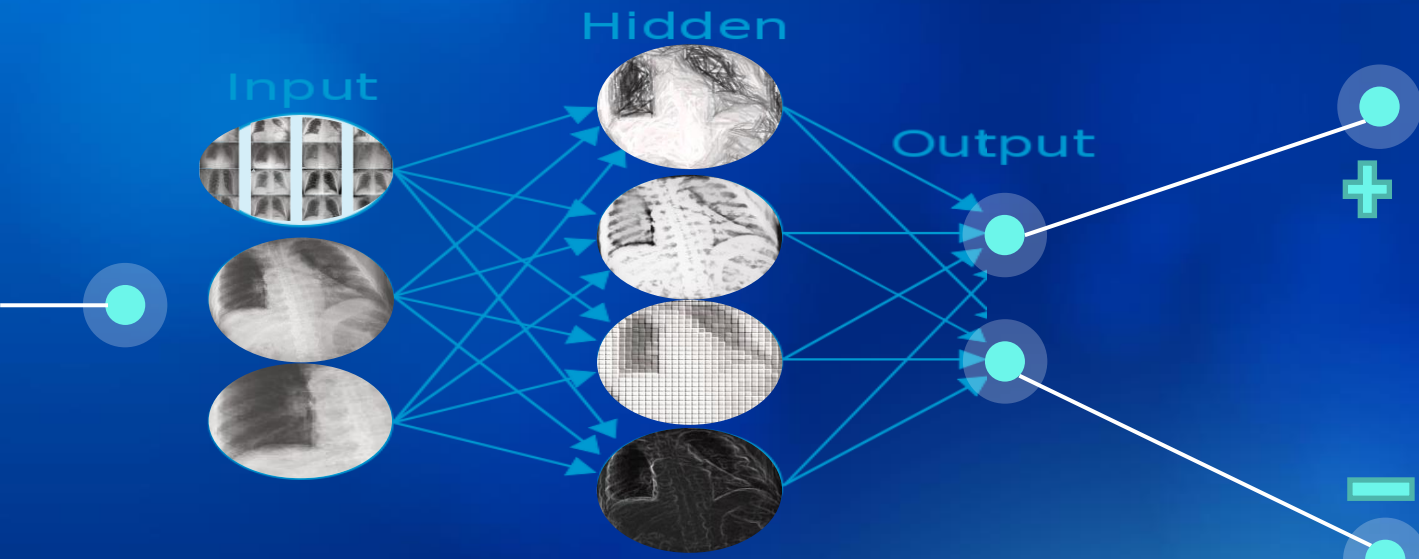
At risk travelers are scanned for xray images

Non-Risk

No further testing, cleared for travel.

Proposal pt.2

Generate a Convolutional Neural Network (CNN) which detects the presence of COVID-19 in CT images with a **high** accuracy at airport terminals. Risk assessed travelers with positive results must take further testing before travel.



Further Testing

Cleared for Travel

METRICS FOR SUCCESS

Meeting FDA standards for Covid-19 testing

ACCURACY

Model will accurately predict status of lungs every 80 out of 100 predictions.

RECALL

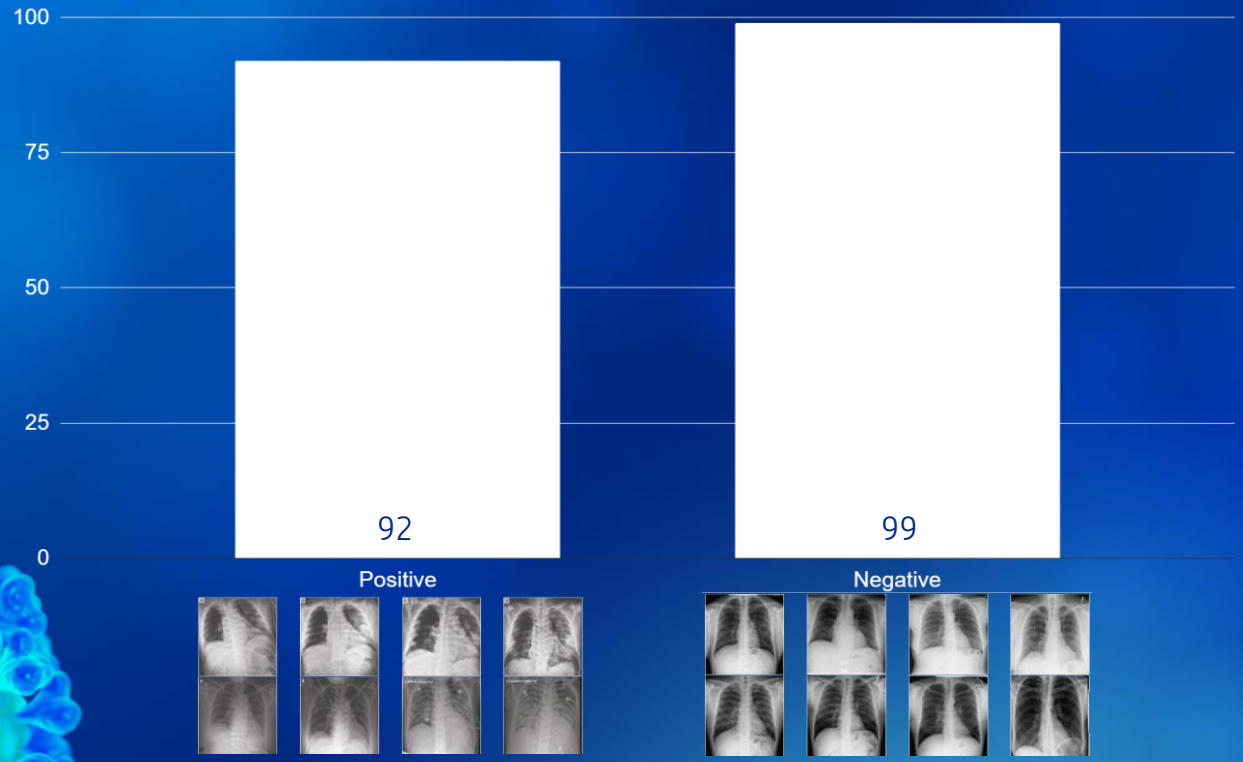
Model will identify at least 90% of positive cases.

VISUALIZATIONS

Generate imaging that can be useful for medical professionals to identify Covid-19 in patients

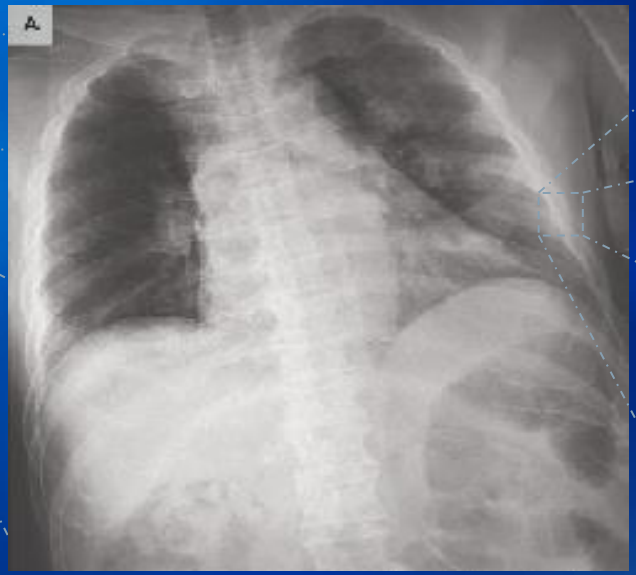
Data

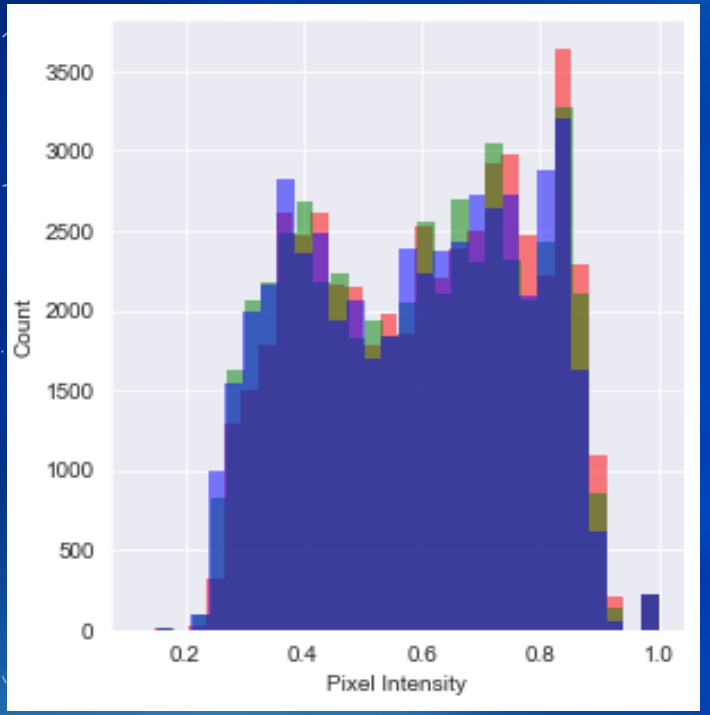
Distribution of images



Exploring the Data

Covid Positive Image





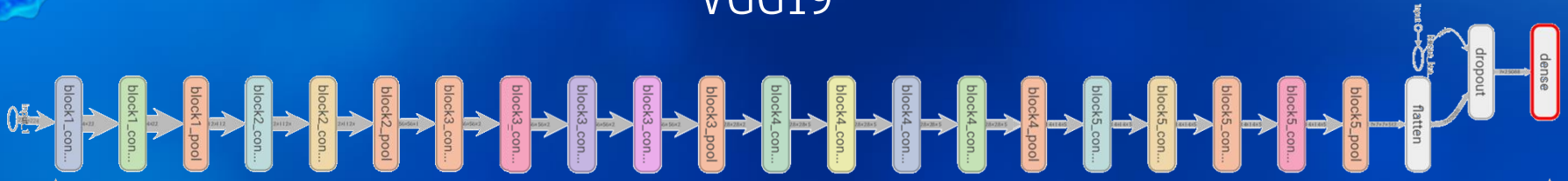
R

G

B

Model

VGG19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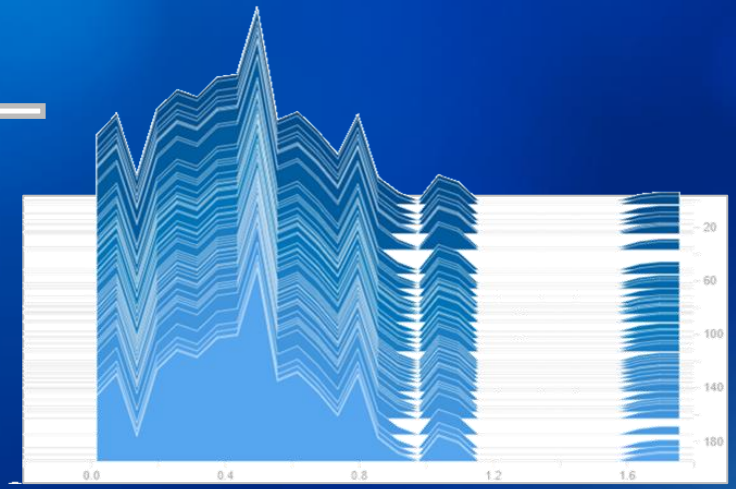
dropout
dense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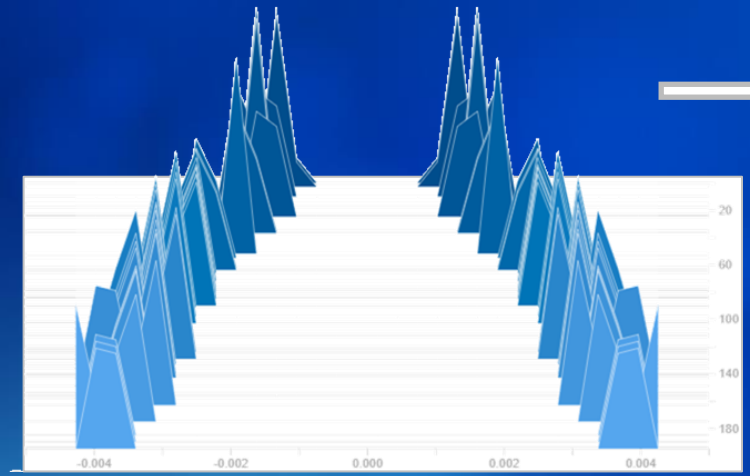
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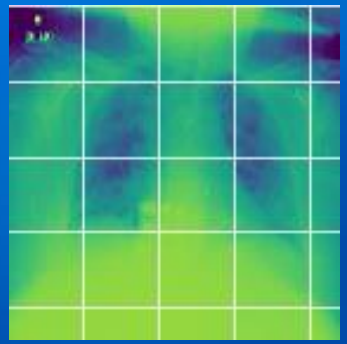
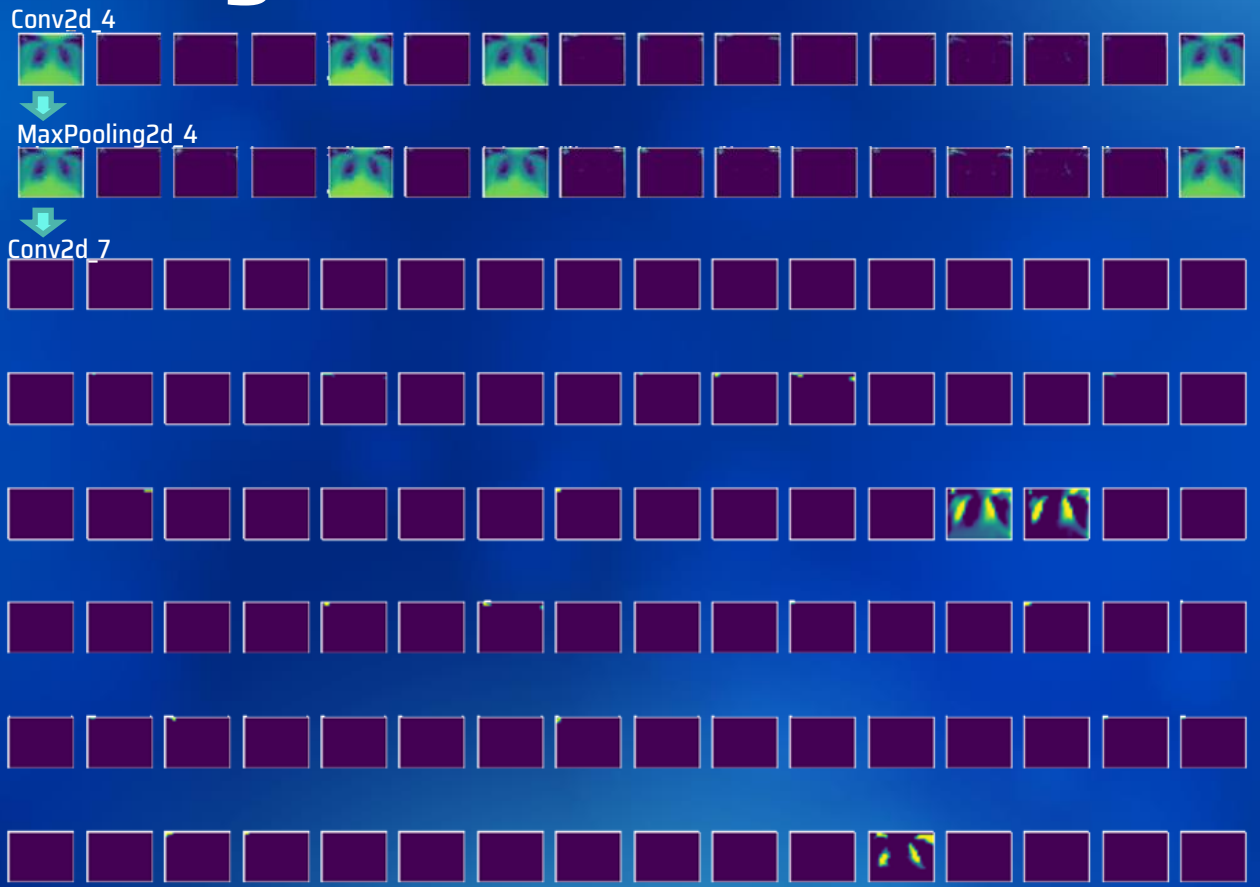
Modeling the Features



First & Last Layers Of CNN



MODEL PERFORMANCE

	Positive	Negative
Accuracy	0.90	0.90
Precision	0.86	0.94
Recall	0.95	0.85
F1- Score	0.90	0.89
Total	19	20

Recommendations

01.

Strategic Placement

Placement of the expensive CT scans should be in the most populated and at risk airports.

02.

Risk Assessment

Up-to-date location and social tracing technologies should be used to assess traveler's likelihood of infection.

03.

Utilize Data

Images should be used to improve performance of model and insights shared with professionals in the medical industry.

04.

Expediate Testing

Scans should be conducted by professionals to ensure a speedy assessment of the traveler's status.

Future Work

1. Obtain more data

Through usage of this proposal, more data related to covid positive cases can be collected which can vastly improve the accuracy of the model. More data can also aid researchers and healthcare workers in treatment of patients.

2. Conduct Time Series Analysis

By accurately identifying positive covid-19 cases, improvements in contact tracing can be made, leading to more effective time series analysis that can improve risk assessment and lower false positive red flags at airport terminals.

THANKS!

Do you have any questions?

APPENDIX

- https://papers.nips.cc/paper/8596-transfusion-understanding-transfer-learning-for-medical-imaging.pdf
- Kermany D, Goldbaum M, Cai W et al. Identifying Medical Diagnoses and Treatable Diseases by Image-Based Deep Learning. Cell. 2018; 172(5):1122-1131. doi:10.1016/j.cell.2018.02.010.
- https://keras.io/applications/
- https://livebook.manning.com/book/deep-learning-with-python/chapter-5/52
- https://towardsdatascience.com/a-comprehensive-hands-on-guide-to-transfer-learning-with-real-world-applications-in-deep-learning-212bf3b2f27a
- Very Deep Convolutional Networks for Large-Scale Image Recognition K. Simonyan, A. Zisserman arXiv:1409.1556
- https://developer.ibm.com/articles/using-deep-learning-to-take-on-covid-19/
- https://github.com/casperbh96/COVID-19-Detection/blob/master/Deep_Learning_for_COVID_19.ipynb
- Wang, L., & Wong, A. (2020). COVID-Net: A Tailored Deep Convolutional Neural Network Design for Detection of COVID-19 Cases from Chest Radiography Images. arXiv:2003.09871.