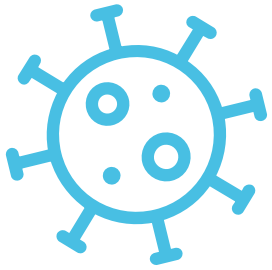
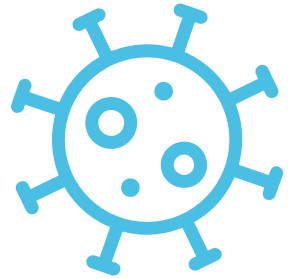
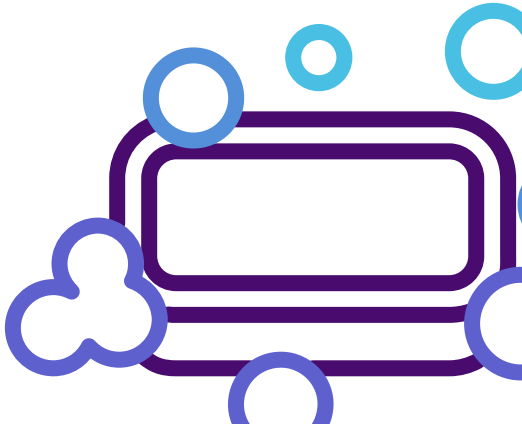



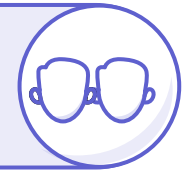
# Machine Learning and COVID-19



# Agenda

01 The Problem 

02 ML and COVID 

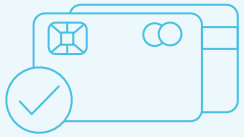
03 Findings 

04 Discuss Opportunities 

# A Public Health Crisis

The virus

SARS coronavirus, first reported Dec 2019



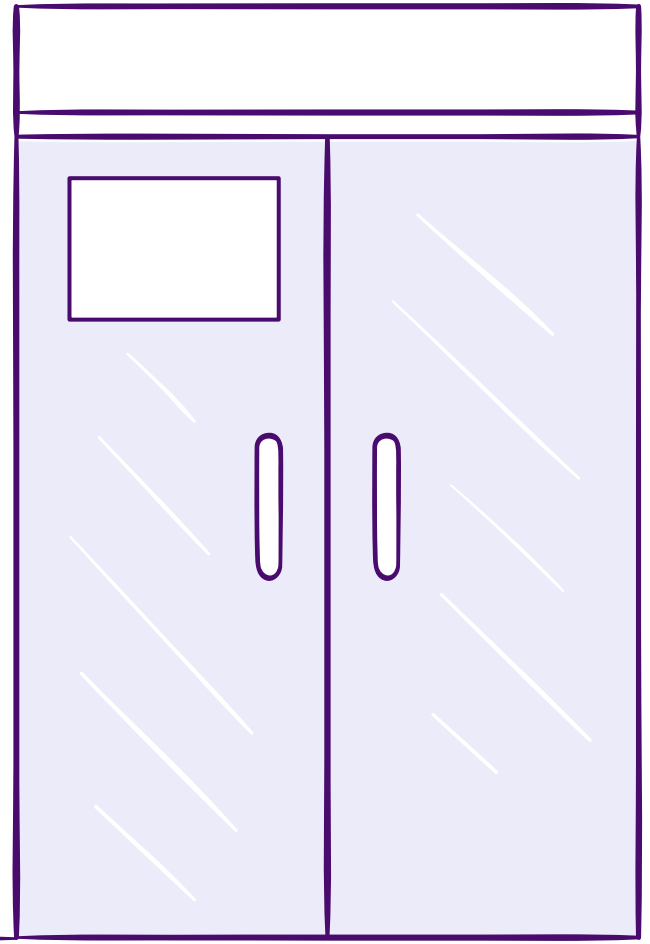
What we know

Developed vaccine, effective testing



What we don’t

Human responses to virus are varied, not fully understood



# Machine Learning Solution

1

## Data

Start with our dataset

2

## Process Data

Resize, shuffle, split, and load

3

## Baseline models

Build random forest and custom CNN models

4

## Transfer learning

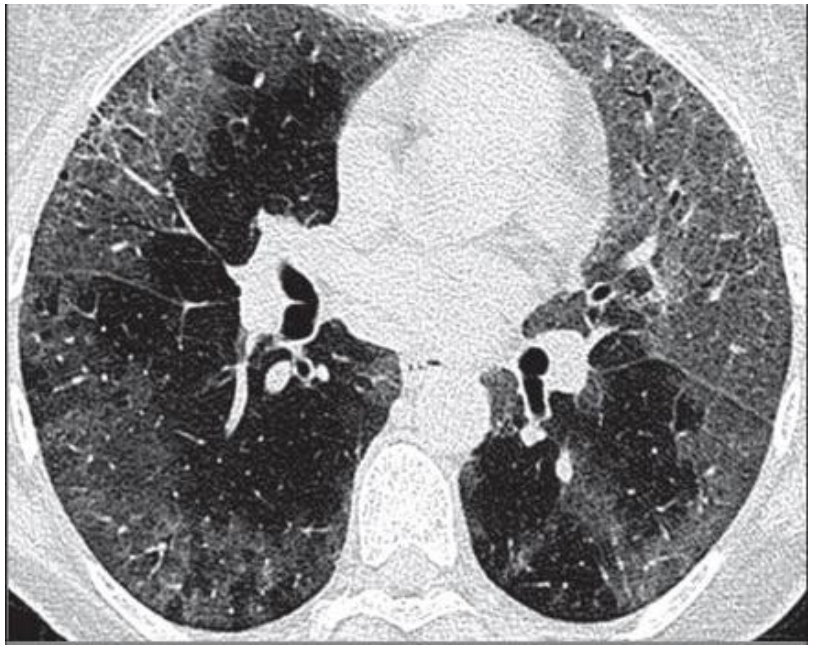
Incorporate known pre-trained models

5

## Tuning

Regularize, adjust hyperparameters

# The Data



746 CT-scans of lungs from research papers

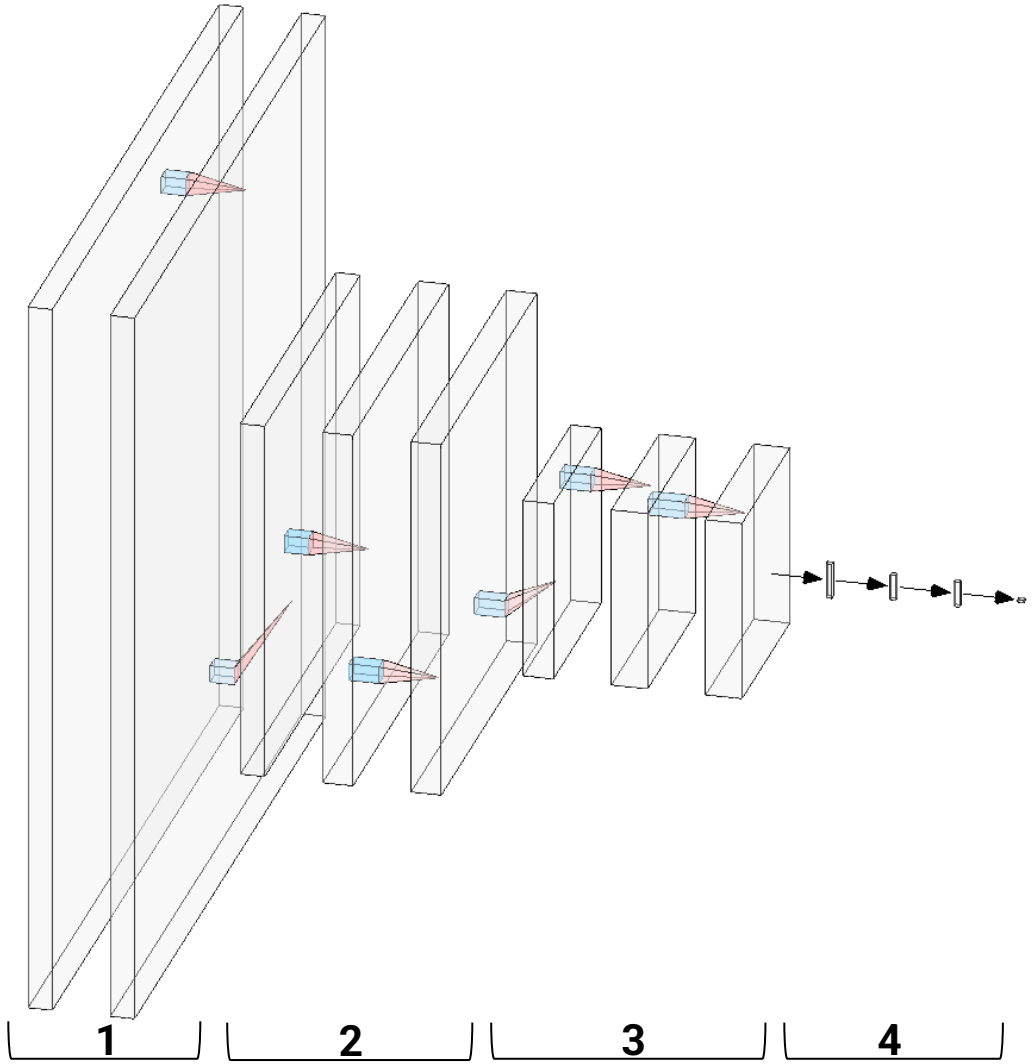
349 COVID positive, 397 COVID negative

Png format, image sizes varied

COVID Negative

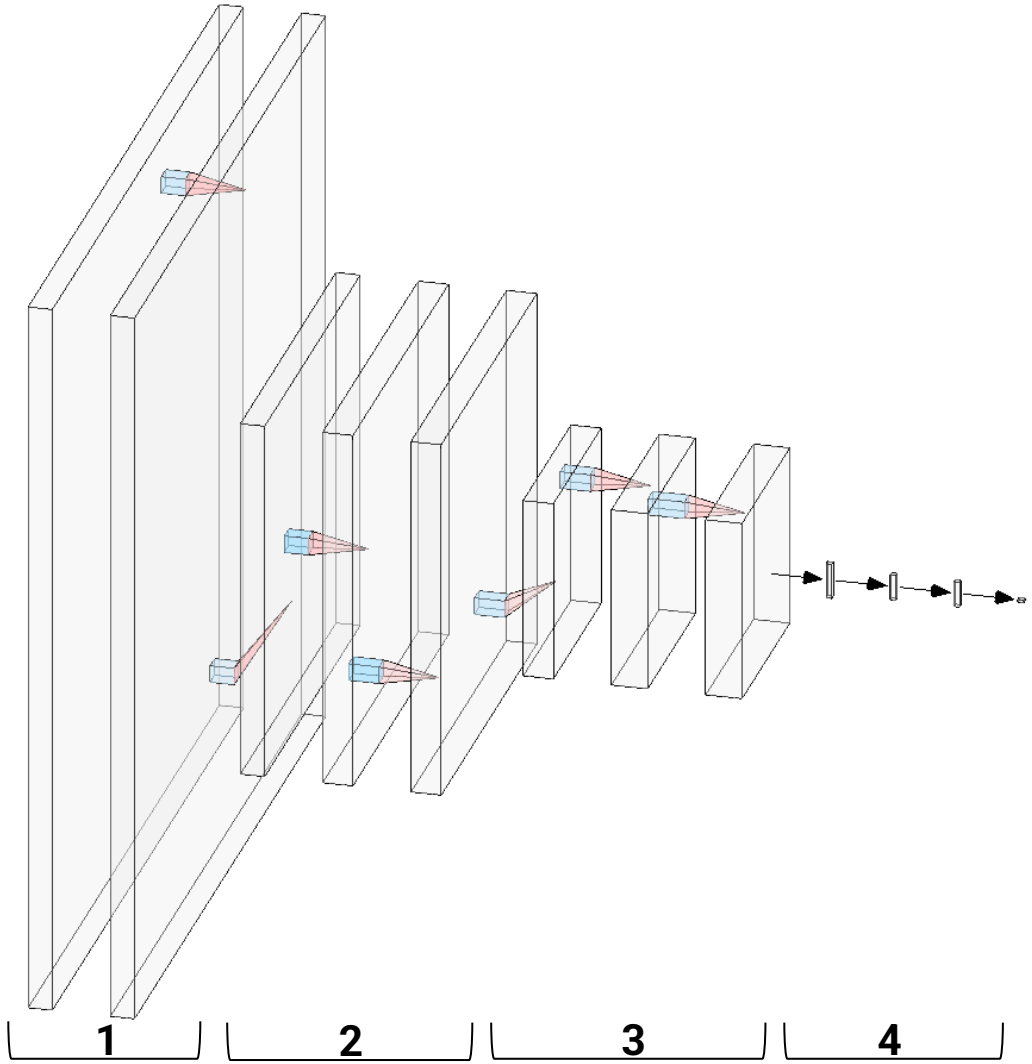
COVID Positive

# Building a base CNN model



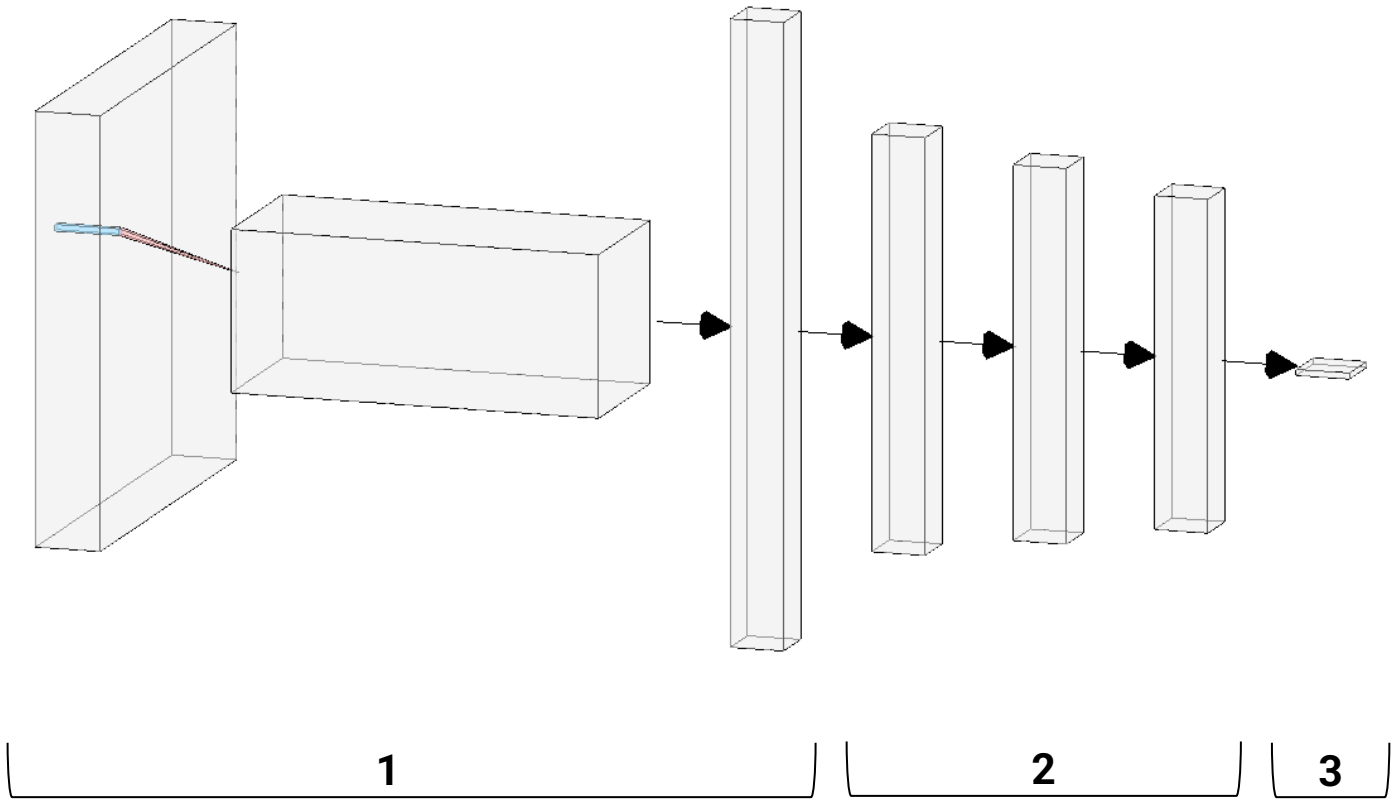

1. Convolutional block
   - 2 convolutional layers w/ 2 dropout layers
2. Convolutional block
   - 2 convolutional layers w/ 2 dropout layers
3. Convolutional block
   - 2 convolutional layers w/ 2 dropout layers
4. Fully connected block
   - 3 dense layers of decreasing size

# Building a base CNN model



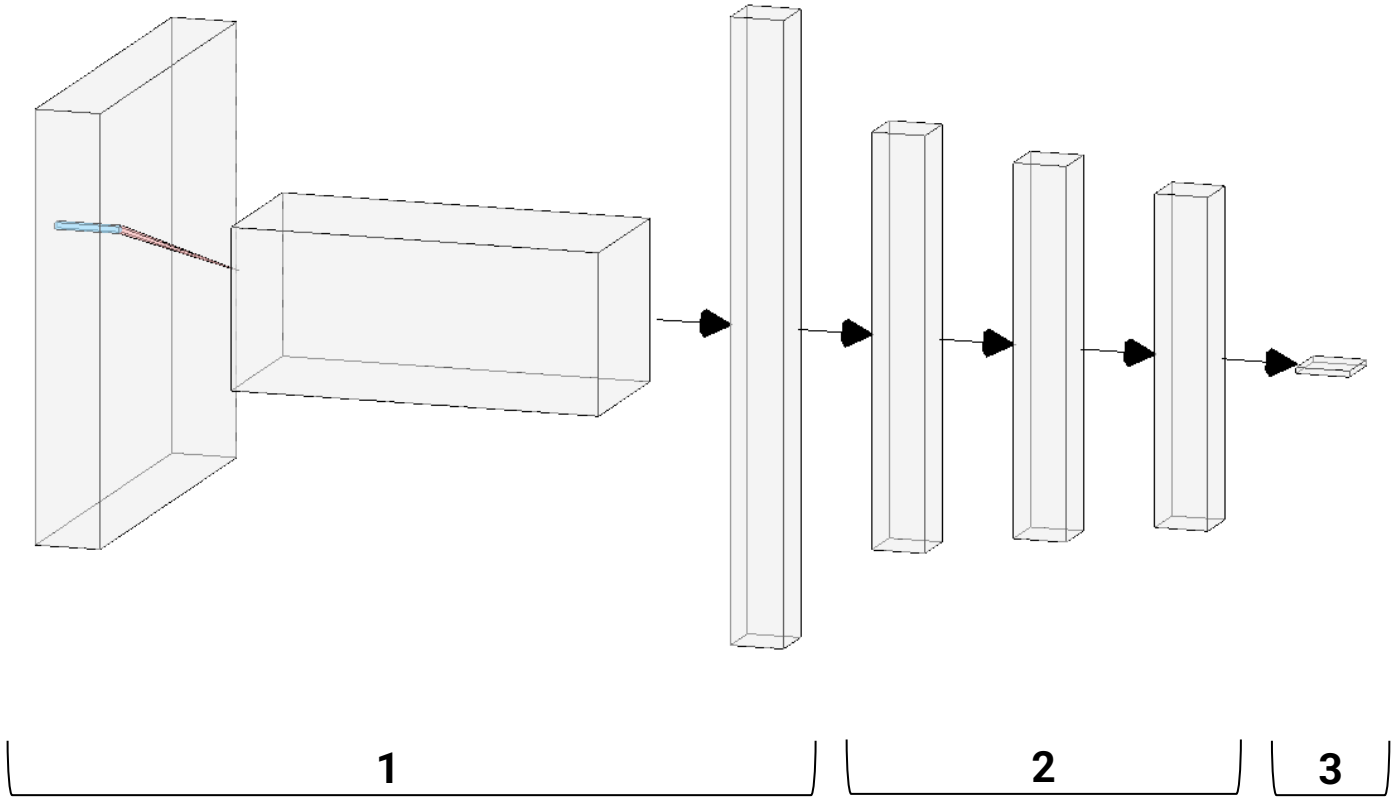

63.1%

# Applying Transfer Learning




1. VGG16 Block
2. Fully connected block
   - 3 dense layers of decreasing size
   - 2 dropout layers
3. Output layer
   - Sigmoid activation

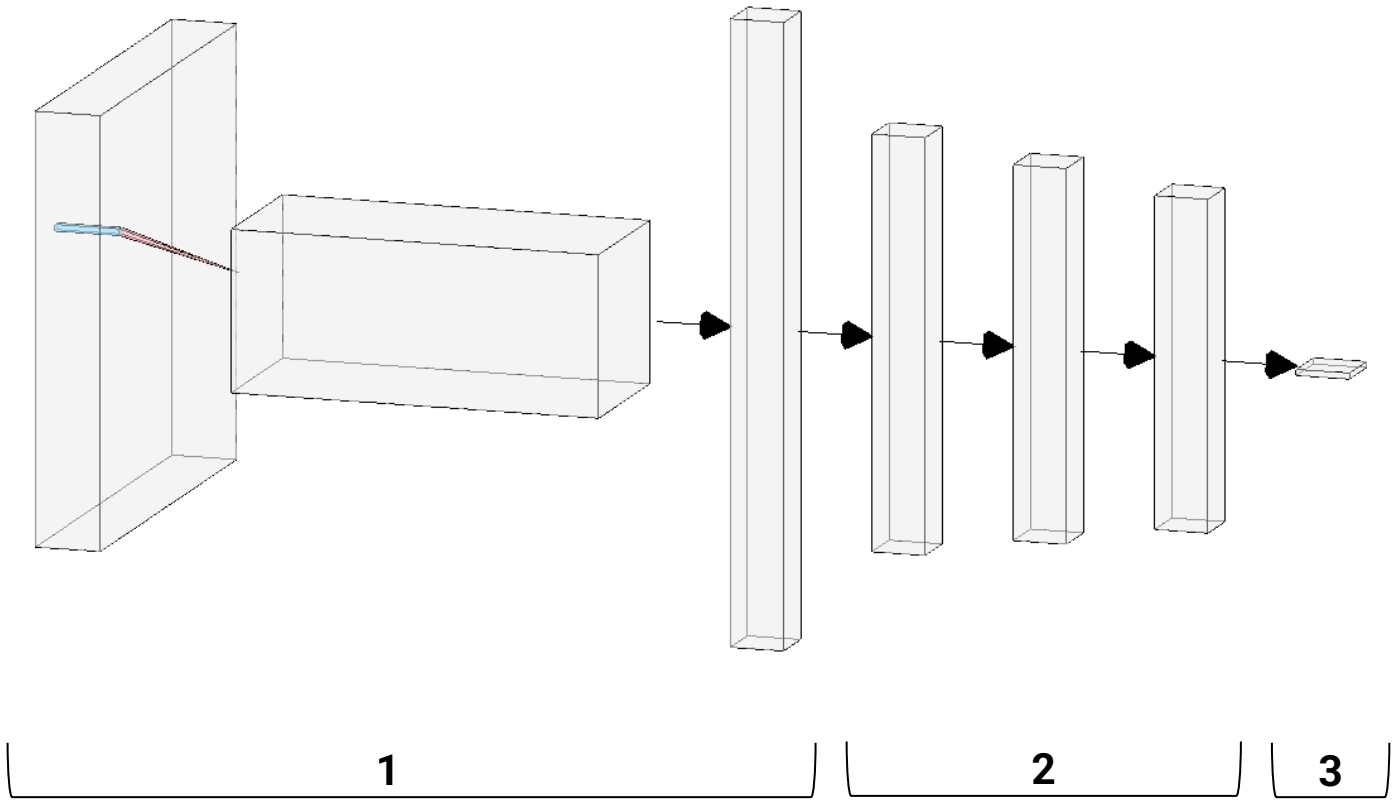
# Applying Transfer Learning




## Tuning

- Implemented number of dropout layers
- Employed SGD optimizer
  - Employed high momentum and scaling learning rate
- Early stopping

# Applying Transfer Learning



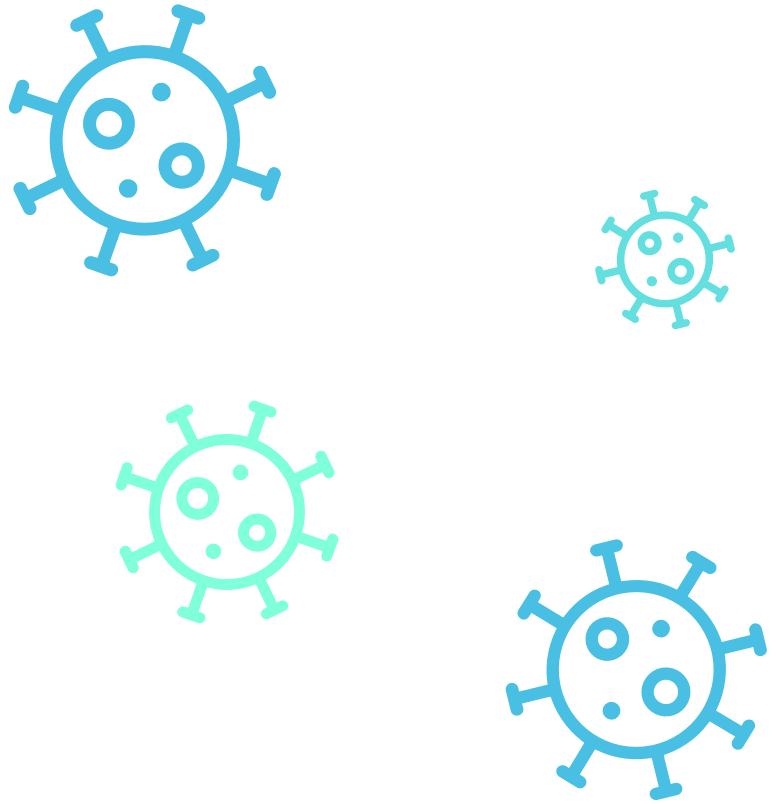

72.2%

# Takeaways

Current model is NOT a valid diagnostic tool

ML shows promise in interpreting COVID image data

Incorporate better preprocessing, more diverse data



# Thank you!

## Questions?


matthewryan33@gmail.com


/maneaterrbug


/matt-mcg-ryan

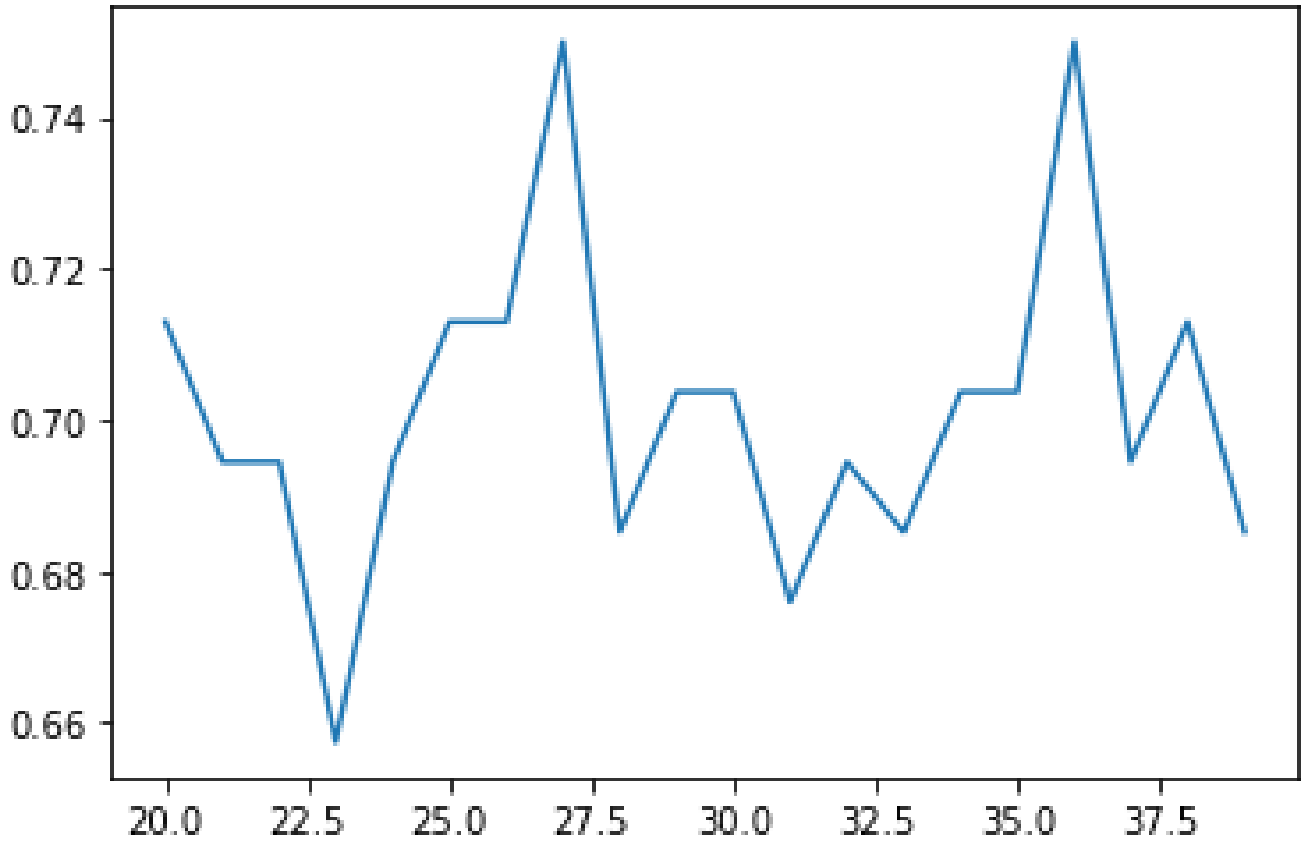
# Appendix I

| Layer (type) | Output Shape | Param # |
|---|---|---|
| conv2d_17 (Conv2D) | (None, 256, 256, 16) | 448 |
| dropout_16 (Dropout) | (None, 256, 256, 16) | 0 |
| conv2d_18 (Conv2D) | (None, 256, 256, 16) | 2320 |
| dropout_17 (Dropout) | (None, 256, 256, 16) | 0 |
| max_pooling2d_6 (MaxPooling 2D) | (None, 128, 128, 16) | 0 |
| conv2d_19 (Conv2D) | (None, 128, 128, 32) | 4640 |
| dropout_18 (Dropout) | (None, 128, 128, 32) | 0 |
| conv2d_20 (Conv2D) | (None, 128, 128, 32) | 9248 |
| dropout_19 (Dropout) | (None, 128, 128, 32) | 0 |
| max_pooling2d_7 (MaxPooling 2D) | (None, 64, 64, 32) | 0 |
| conv2d_21 (Conv2D) | (None, 64, 64, 64) | 18496 |
| dropout_20 (Dropout) | (None, 64, 64, 64) | 0 |
| conv2d_22 (Conv2D) | (None, 64, 64, 64) | 36928 |
| dropout_21 (Dropout) | (None, 64, 64, 64) | 0 |
| global_average_pooling2d_3 (GlobalAveragePooling2D) | (None, 64) | 0 |
| flatten_3 (Flatten) | (None, 64) | 0 |
| dense_7 (Dense) | (None, 20) | 1300 |
| dense_8 (Dense) | (None, 20) | 420 |
| dense_9 (Dense) | (None, 1) | 21 |

Total params: 73,821
Trainable params: 73,821
Non-trainable params: 0

# Appendix II

Validation set accuracy by number of epochs (base CNN)



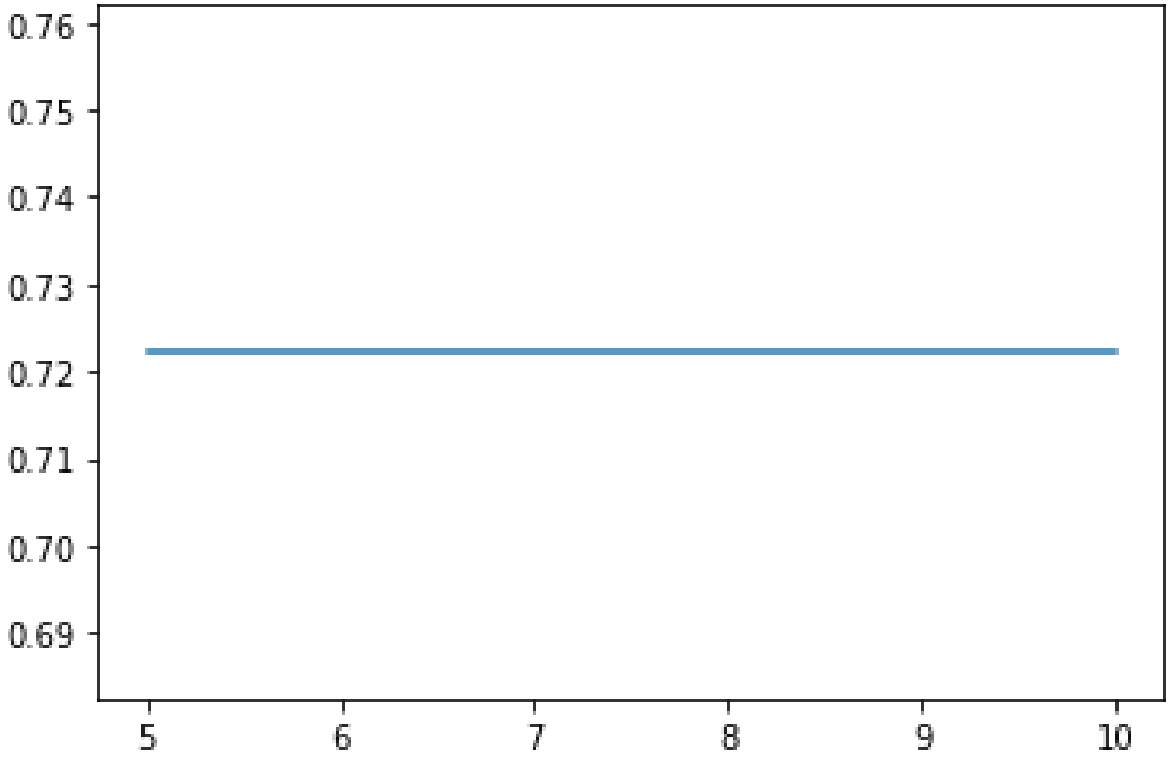
# Appendix III

| Layer (type) | Output Shape | Param # |
|---|---|---|
| vgg16 (Functional) | (None, 8, 8, 512) | 14714688 |
| flatten (Flatten) | (None, 32768) | 0 |
| dense (Dense) | (None, 1000) | 32769000 |
| dropout (Dropout) | (None, 1000) | 0 |
| dense_1 (Dense) | (None, 500) | 500500 |
| dropout_1 (Dropout) | (None, 500) | 0 |
| dense_2 (Dense) | (None, 250) | 125250 |
| dense_3 (Dense) | (None, 1) | 251 |

Total params: 48,109,689
Trainable params: 33,395,001
Non-trainable params: 14,714,688

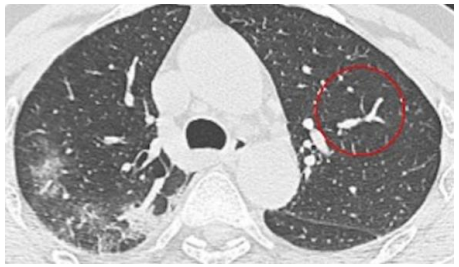
# Appendix IV

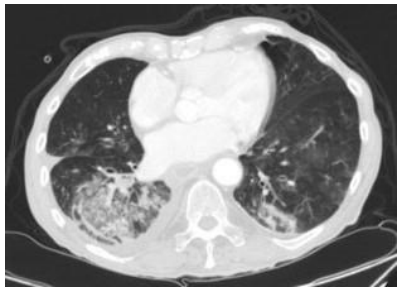
Validation set accuracy by number of epochs
(Transfer CNN)

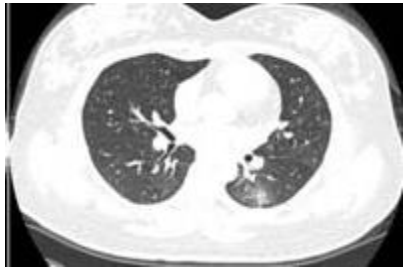
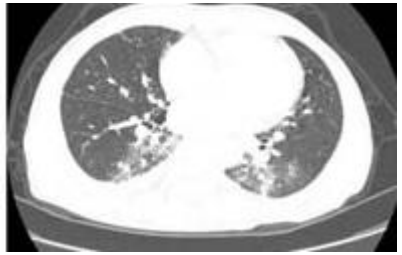


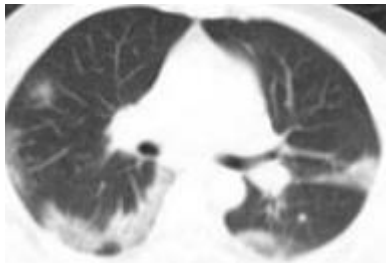
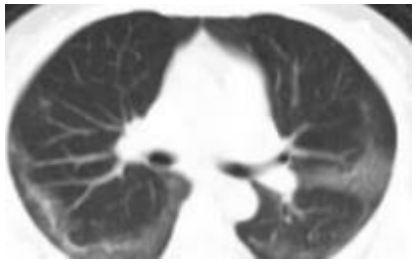
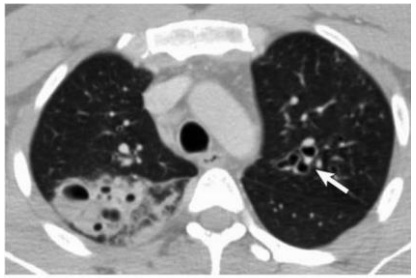
# Appendix V

Example CT-scans



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# Appendix