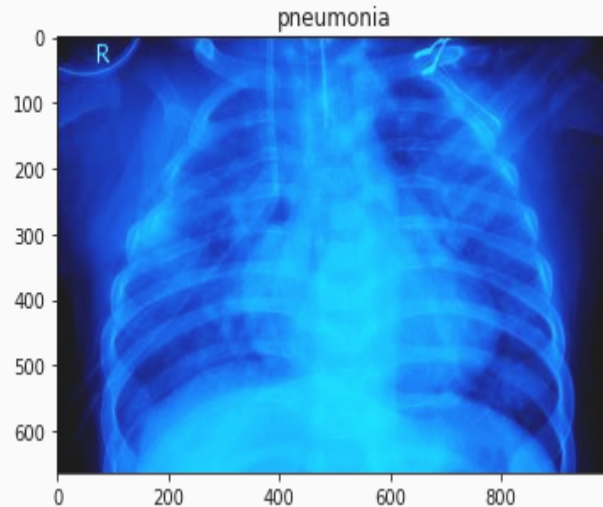
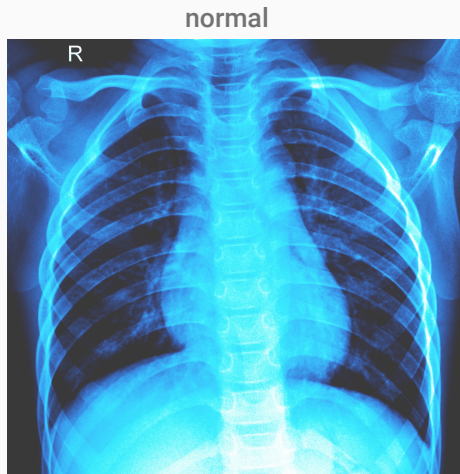


Chest X-Ray Images (Pneumonia) Classification

Machine Learning (ML) Modeling



Pneumonia can be life threatening



Chest X - ray image of patient with pneumonia

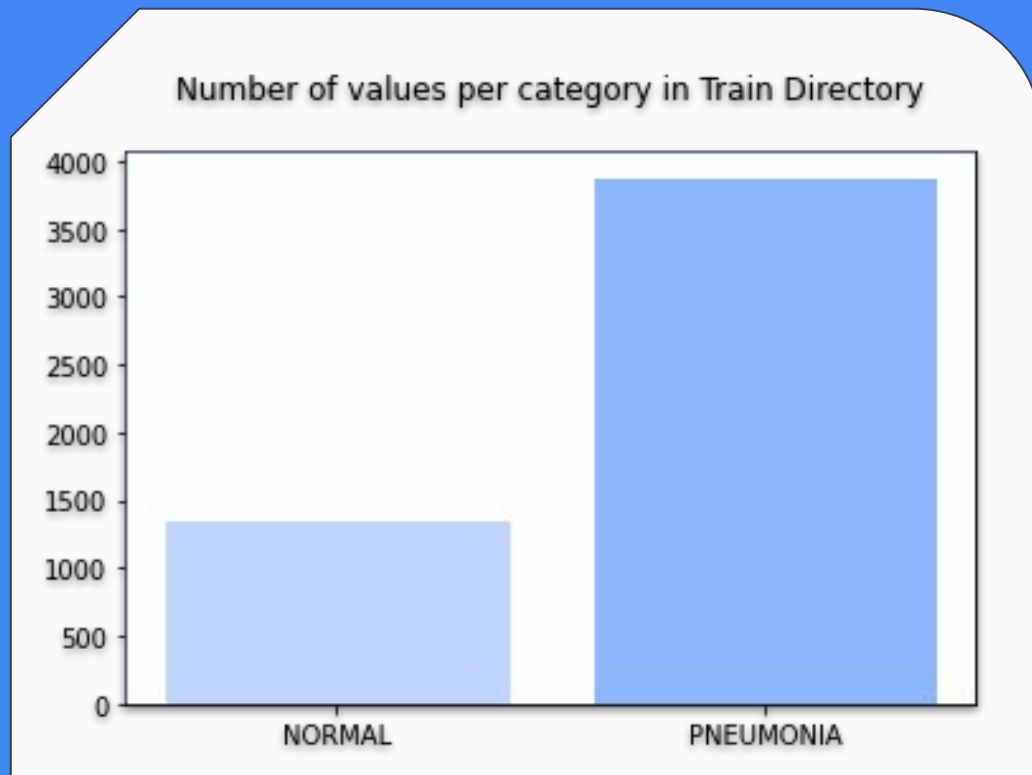
The Project

ML Algorithmic Advantages



- Eliminate manual measurements
- Prevent detection errors
- Lower patient and medical legal risk
- Reduce provider workflow

The Training Data

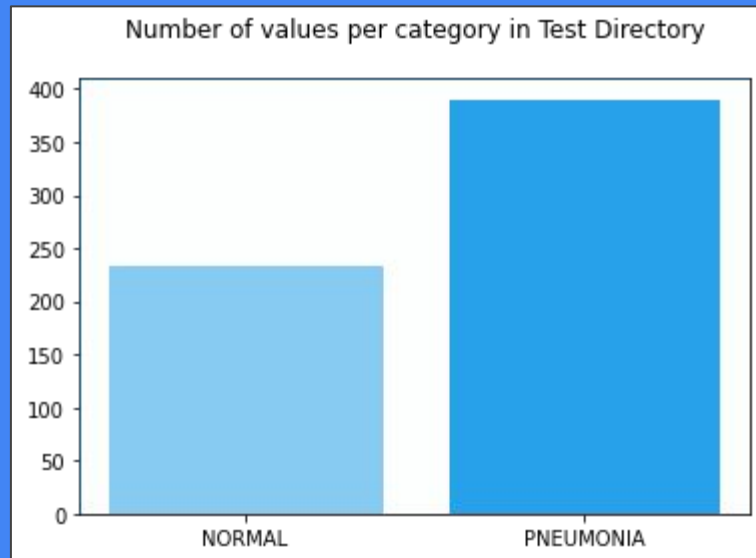


Test Data:

NORMAL: 234 (37.5%)

PNEUMONIA: 390
(62.5%)

Total images: 624



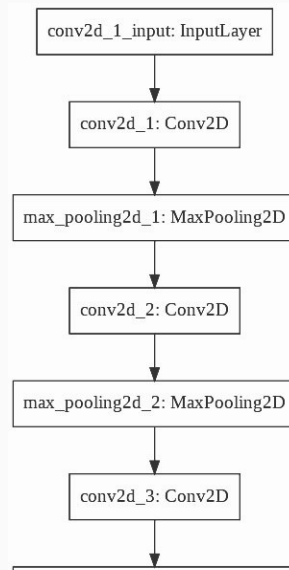
““Machine intelligence is the last invention
that humanity will ever need to make.”

- Nick Bostrom, Swedish philosopher at the University of Oxford

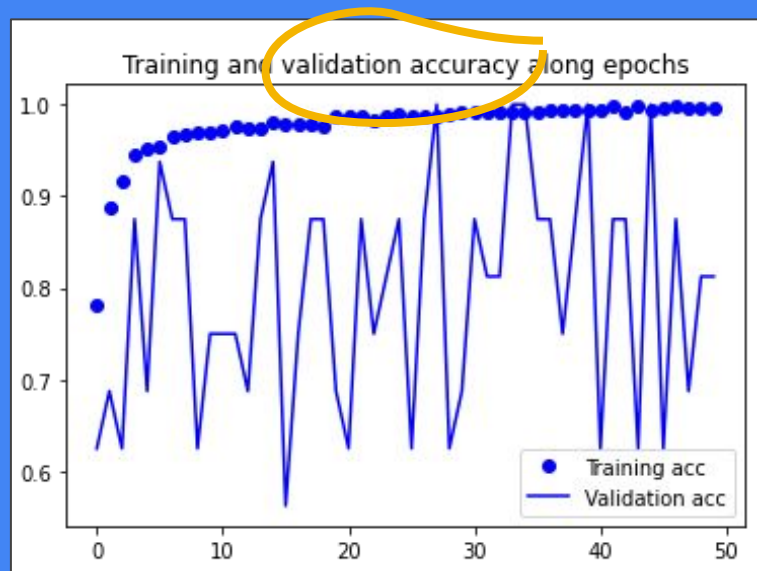
Model Architecture

Model: "sequential_1"

Layer (type)	Output Shape	Param #
=====		
==		
conv2d_1 (Conv2D)	(None, 148, 148, 32)	896
max_pooling2d_1 (MaxPooling2D)	(None, 74, 74, 32)	0
conv2d_2 (Conv2D)	(None, 72, 72, 64)	18496
=====		
flatten_1 (Flatten)	(None, 331776)	0
dense_1 (Dense)	(None, 64)	21233728
dense_2 (Dense)	(None, 1)	65
=====		
Total params: 21,253,185		
Trainable params: 21,253,185		
Non-trainable params: 0		



The Tests

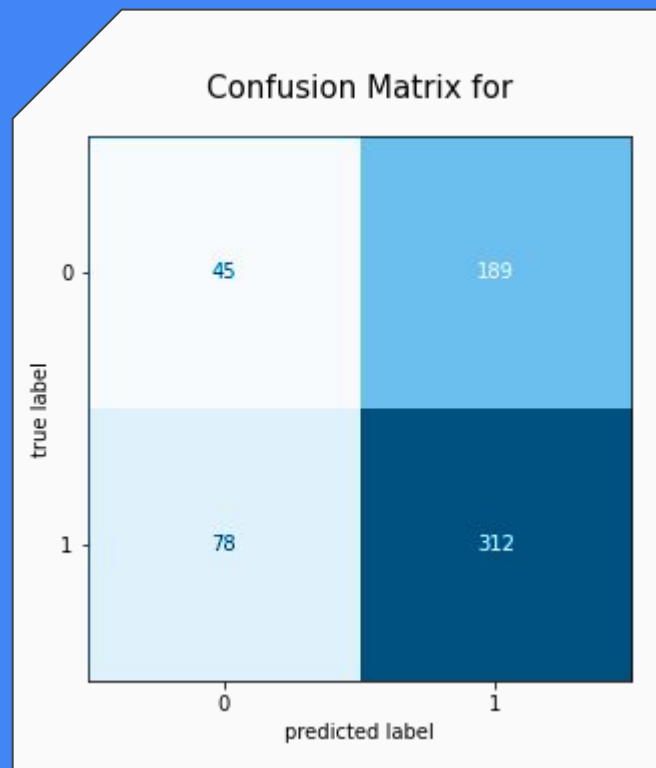


Model 1 Results

Predicted 'NORMAL': 123

Predicted 'PNEUMONIA': 501

```
Found 624 images belonging to 2 classes.  
test loss: 0.9870075583457947  
test acc: 0.8028846383094788
```



'0' = normal

"1" = Pneumonia

Encouraging, though not ideal:

- **True Negatives** - correctly predicted to not to have pneumonia: 45
- **True Positives** - correctly predicted to have pneumonia: 312
- **False Negatives** - falsely predicted to not to have pneumonia: 78
- **False Positives** - falsely predicted to have pneumonia: 189

False positives preferred over false negatives.

- Where false positives could unnecessarily result in additional testing, false negatives could result in failure to treat patients that require treatment.
- Now, our target is a model that achieves lower error, overall.

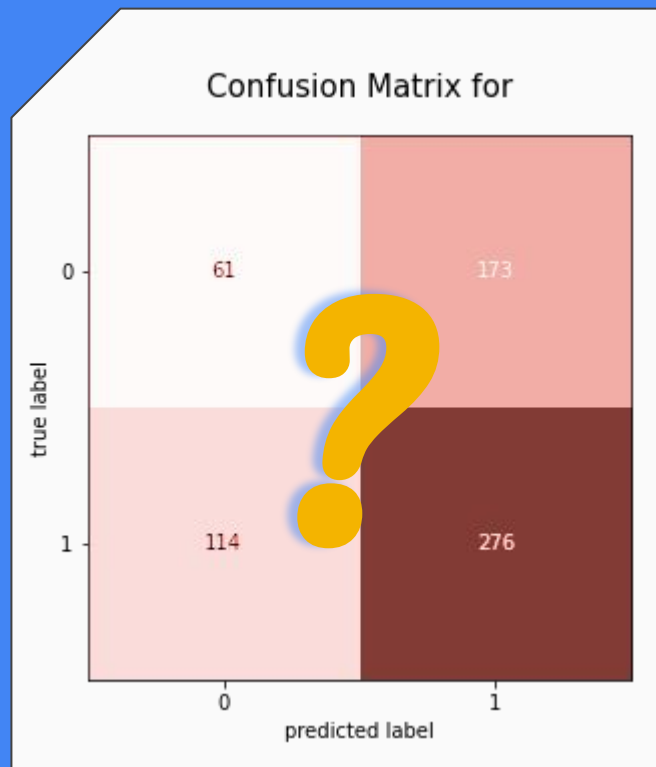
A 2nd Model

(changes must be supervised)

Predicted 'NORMAL': 175

Predicted 'PNEUMONIA': 449

↑	TN = 61	(9.78 %)
↓	TP = 276	(44.23 %)
↑	FN = 114	(18.27 %)
↓	FP = 173	(27.72 %)



While stable models may be deployed to clinical teams and run without the need for adjustment, model design is **supervised** to ensure changes do not adversely affect test results.

Metrics

90 minutes training and testing design can result in a reusable model that can make predictions on a dozen x - ray images in fewer than 60 seconds.

```
Epoch 1/30  
100/100 [=====] - 223s 2s/step - loss:  
10.3657 - acc: 0.6851 - val_loss: 0.6920 - val_acc: 0.6250
```

```
Epoch 00001: val_loss improved from inf to 0.69203, saving  
model to ./models/p3_model_3.h5
```

```
Epoch 2/30  
100/100 [=====] - 210s 2s/step - loss:  
0.5616 - acc: 0.7814 - val_loss: 0.6916 - val_acc: 0.6875
```

```
Epoch 00002: val_loss improved from 0.69203 to 0.69161, saving  
model to ./models/p3_model_3.h5
```

```
Epoch 3/30  
14/100 [==>.....] - ETA: 1:59 - loss:  
0.4875 - acc: 0.7927
```

Time - Accuracy

Future Work

This is not the end!

Models can be saved, revised for
improvement, and
re - deployed.



Thanks!

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