Pneumonia Detection

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1. Background

Pneumonia is an infection that inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus (purulent material), causing cough with phlegm or pus, fever, chills, and difficulty breathing. A variety of organisms, including bacteria, viruses and fungi, can cause pneumonia.

Pneumonia can range in seriousness from mild to life-threatening. It is most serious for infants and young children, people older than age 65, and people with health problems or weakened immune systems.

Src: Mayo Clinic

1. Background (cont.)

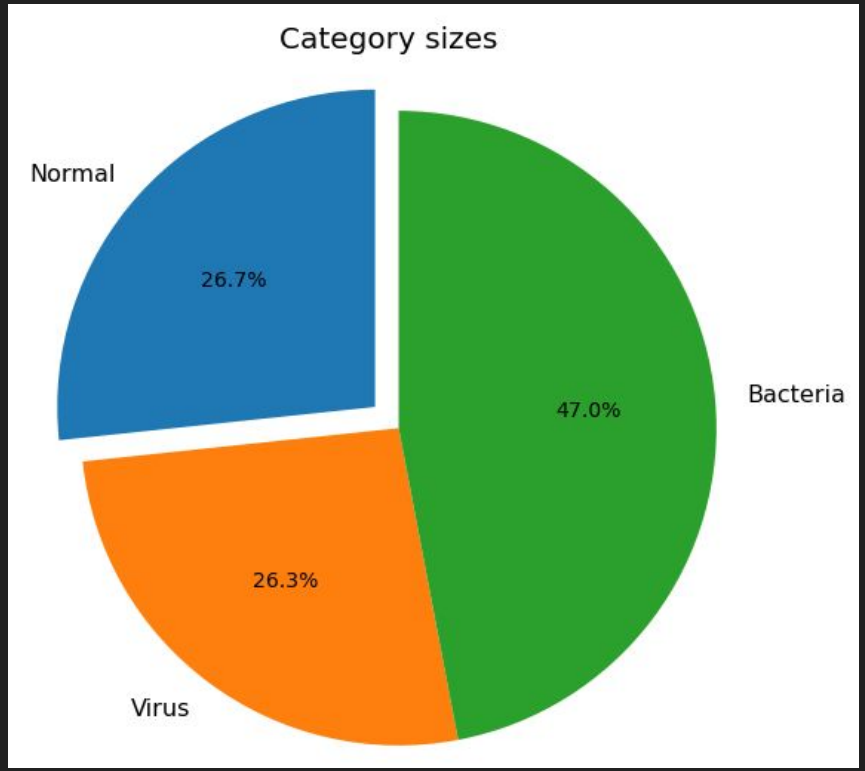
How is pneumonia diagnosed?

- Blood tests
- **Chest X-ray**
- Pulse oximetry
- Sputum test
- CT scan
- Pleural fluid culture

Src: Mayo Clinic

2. Data

- Chest X-rays
- ~ 6,000



2. Data (cont.)

3. Define our Problem

While doctors typically do well at making diagnosis via Chest X-ray they are humans who are often overworked and can suffer from fatigue which can hamper their ability to make a proper diagnosis. A machine learning model can be used to help reduce the false negative rate by acting as a second opinion. In this notebook we will attempt to create said model. The dataset we will be using consists of approximately 6000 images of chest x rays to train a convolutional neural network to detect whether a person has virus-related pneumonia, bacteria-related pneumonia, or neither.

TLDR: Train a CNN to detect pneumonia from chest x-rays

4. Criteria for Success

- False Negatives (True = Pneumonia, Predicted = Normal) < 2%
- False Positives (True = Normal, Predicted = Pneumonia) < 10%

- FN should be very low because under-diagnosis is very bad
- FP is not as bad, but there currently seems to be an issue with over-diagnosis
- Critical for the model to perform well, or it won’t be trusted. Can be seen as annoying

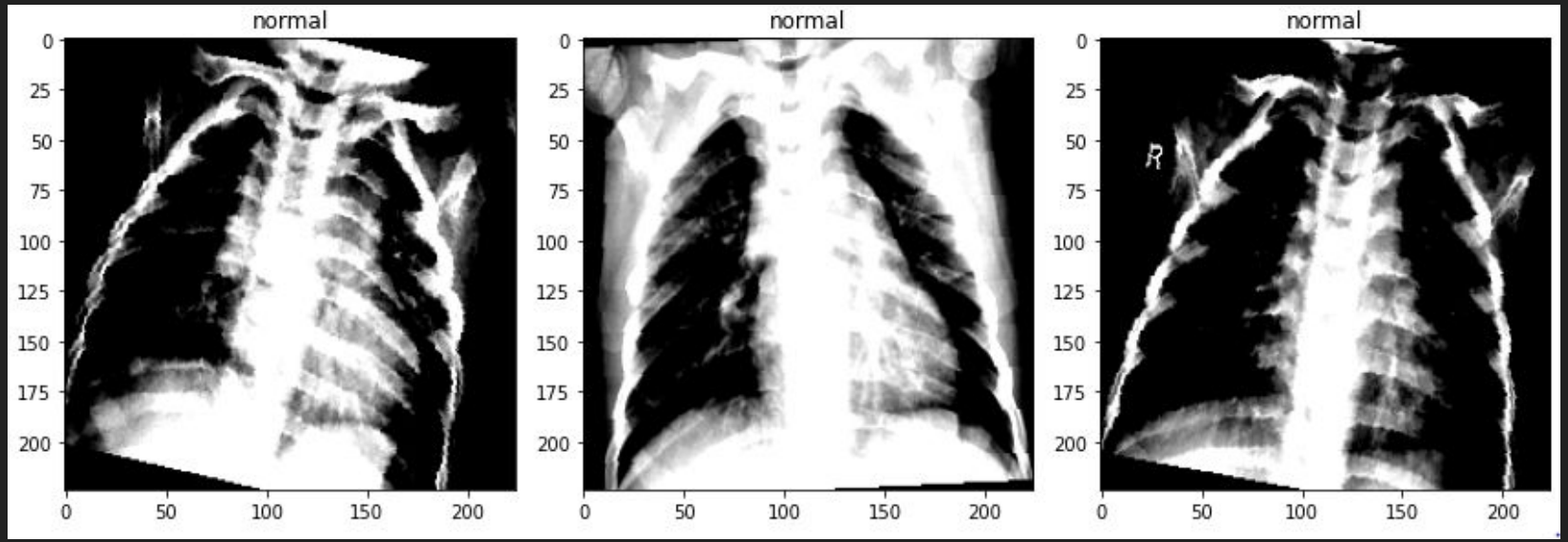
5. Modeling Process

We don’t have much data, so we need to get the most out of what we have.

Data Augmentation Pipeline:

- Scale/Resize
- Random Crop
- Random Horizontal Flip
- Random Jitter (brightness and contrast)
- Random Rotation (15 degrees)
- Standardization (x - mean / std)

5. Modeling Process (cont.)



5. Modeling Process (cont.)

Transfer Learning with ResNet18:

- Pre trained on ImageNet (~14mil images/1000 classes)
- Replace final output with our own softmax for 3 classes
- Freeze early layers/ unfreeze later layers (or blocks of layers)

Resources:

C4W2L03 Resnets

C4W2L04 Why ResNets Work

Understanding and Implementing Architectures of ResNet and ResNeXt

6. Results

- False Negatives
- Success= <2%

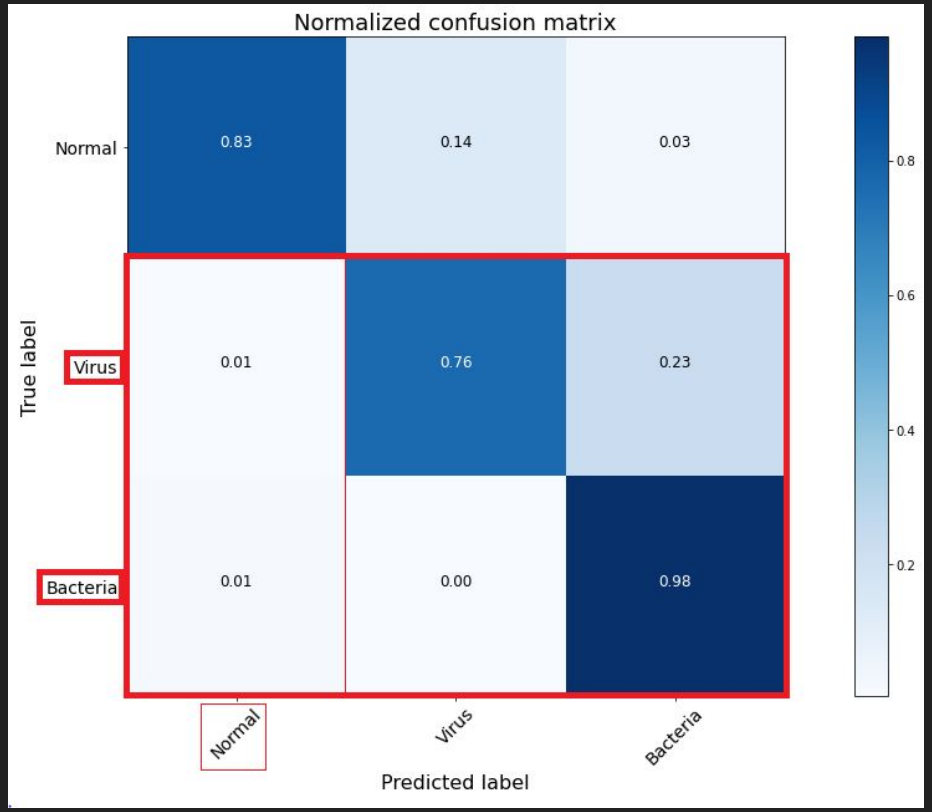
- False Positives
- Success= <10%

6. Results (cont.)

- False Negatives
- Success= < 2%

T= Pneumonia

P = Normal

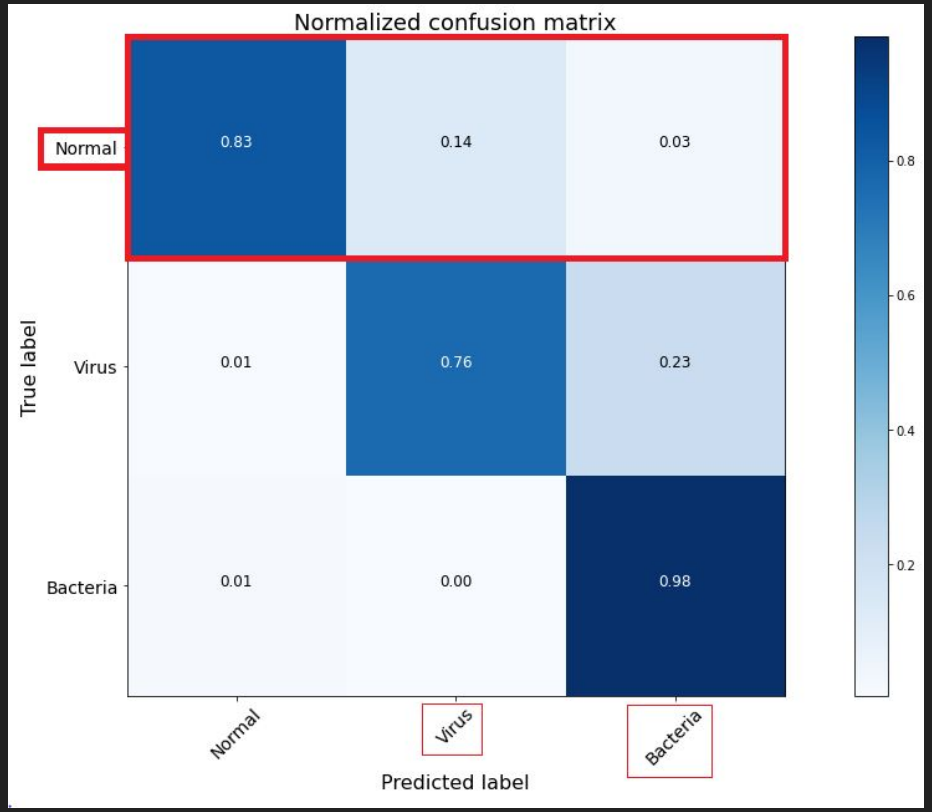


6. Results (cont.)

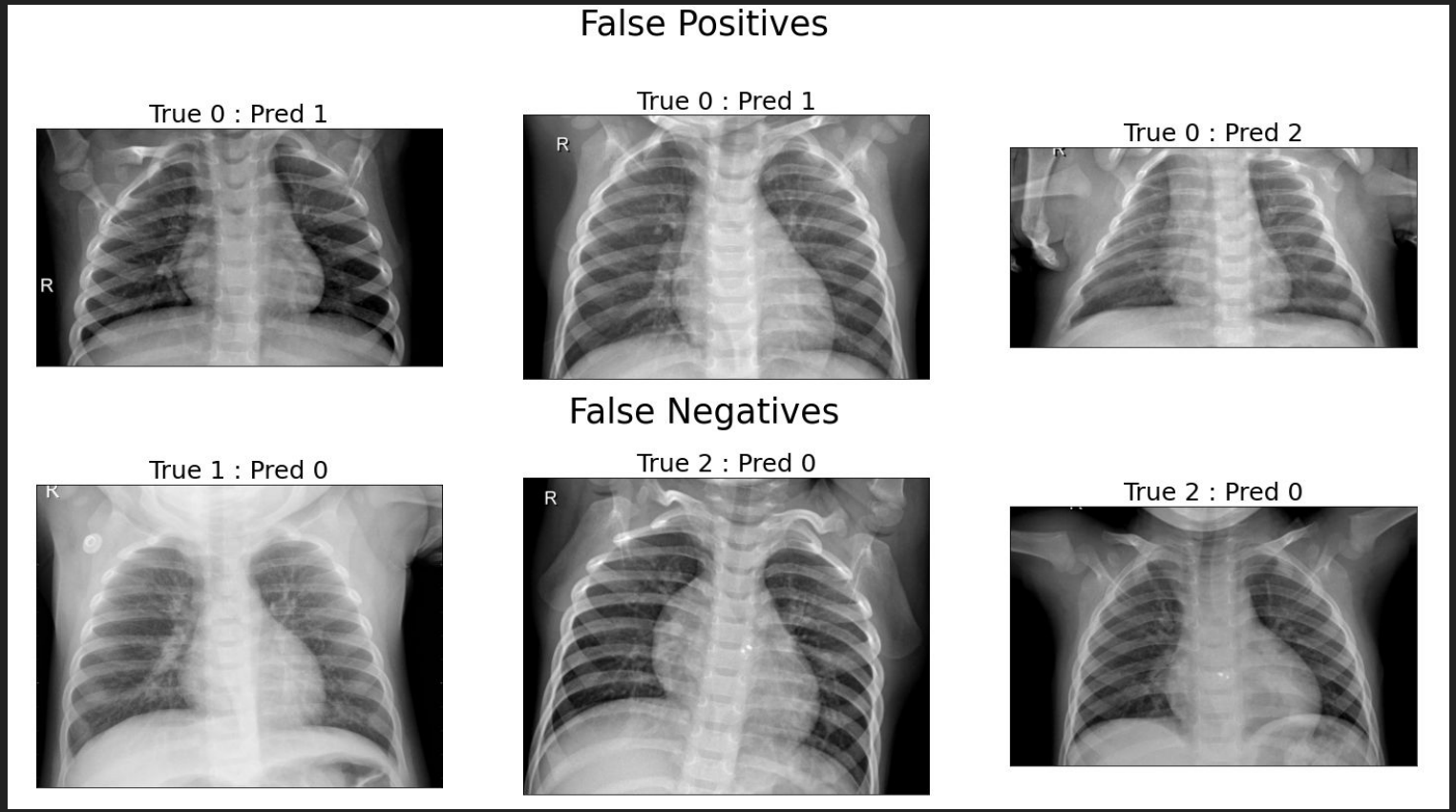
- False Positives
- Success= <10%

T = Normal

P = Pneumonia



6. Results (cont.)



7. Conclusions

- Target FNR: < 2% -------- Actual FNR: 2%
- Target FPR: < 10% ------ Actual FPR: 17%

The model is not yet ready for production!

8. Next Steps

- In general, collect more data!
- Custom loss function
- More data for subclasses (COVID..)

Q & A

I can’t see you, so ask away!