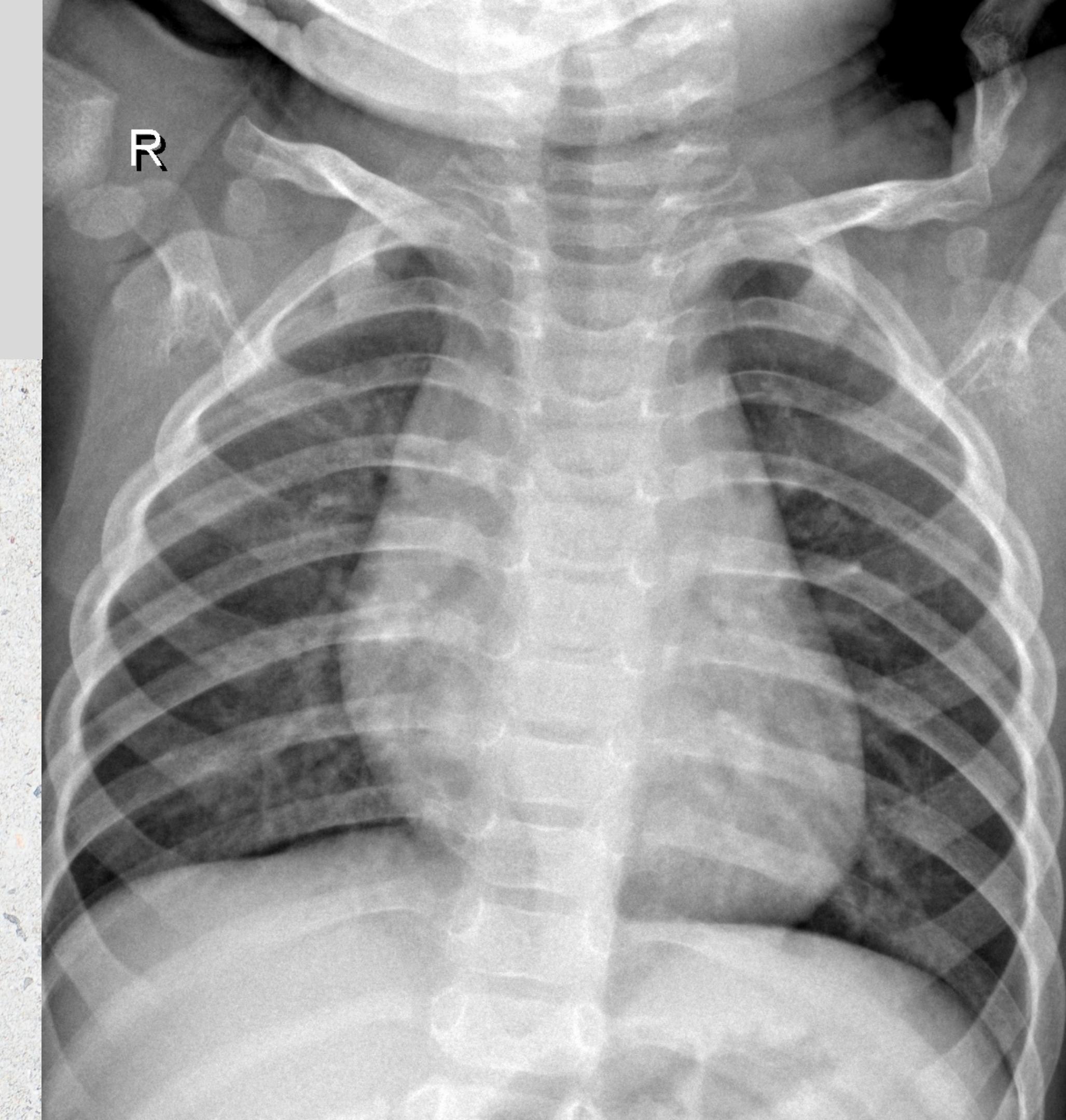


DIAGNOSING PNEUMONIA WITH RADIOGRAPHS AND CNNS

by Tim Hintz
and Nick Subic



- Pneumonia is the leading cause of death in children across the globe
- Nearly 1 in 6 deaths of children between the ages of 1-5 are from pneumonia
- Pneumonia can be accurately diagnosed using chest X-rays by medical professionals



World Health Organization

Overview

Used Convolutional Neural Networks to classify X-Ray images

Created an ensemble classifier using transfer learning

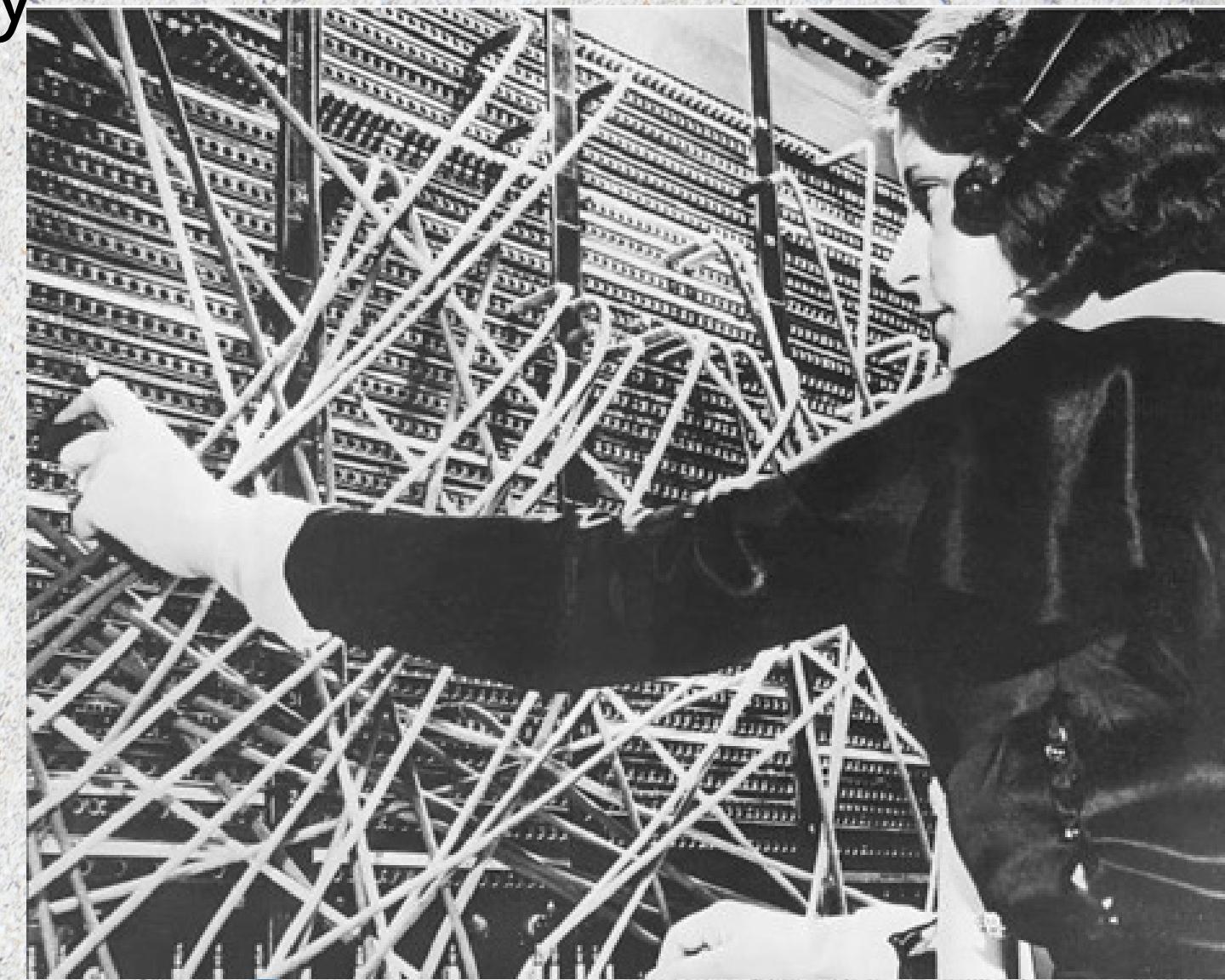
Achieved 90% Accuracy and 99% Recall



TensorFlow



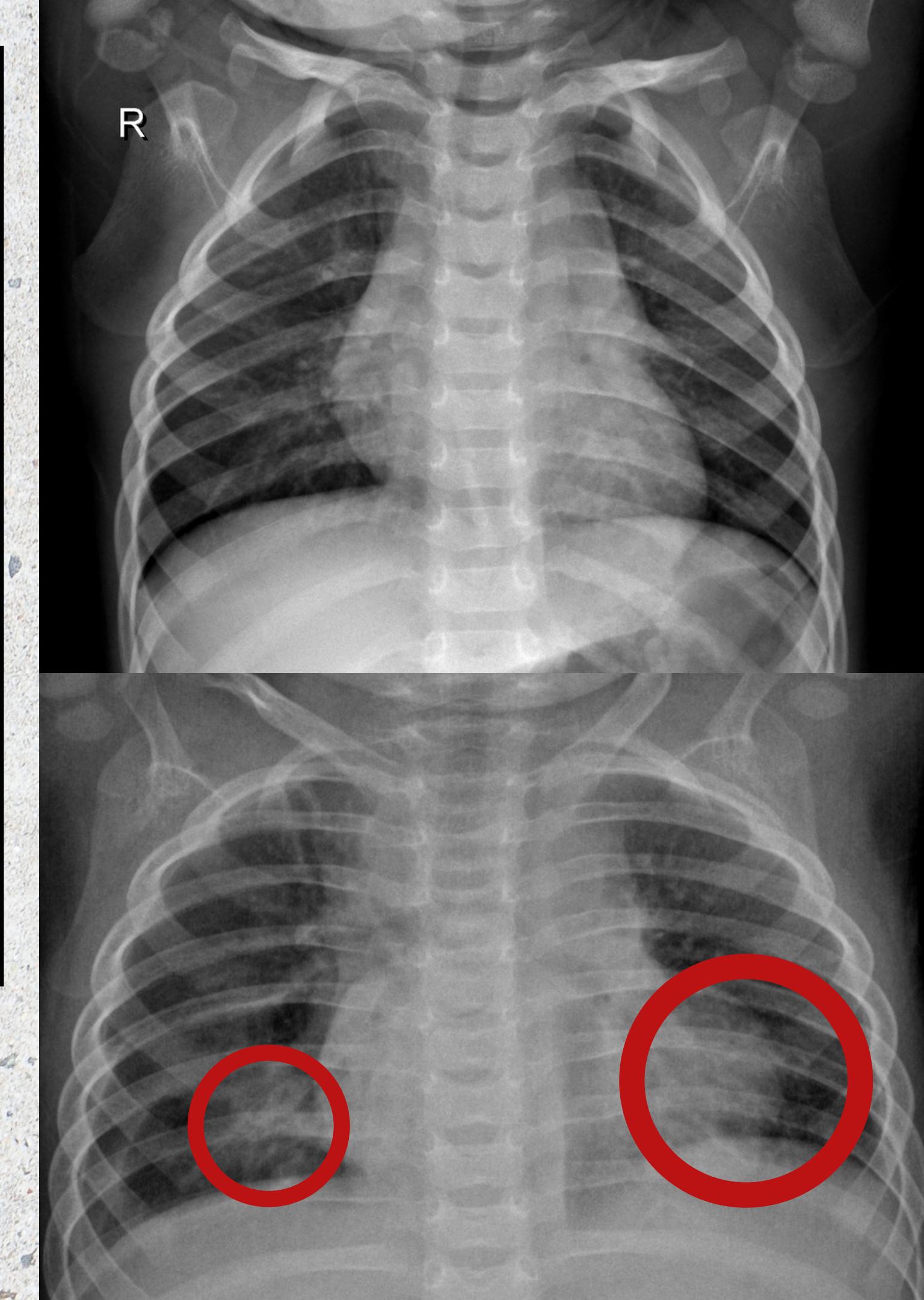
Keras



The Data

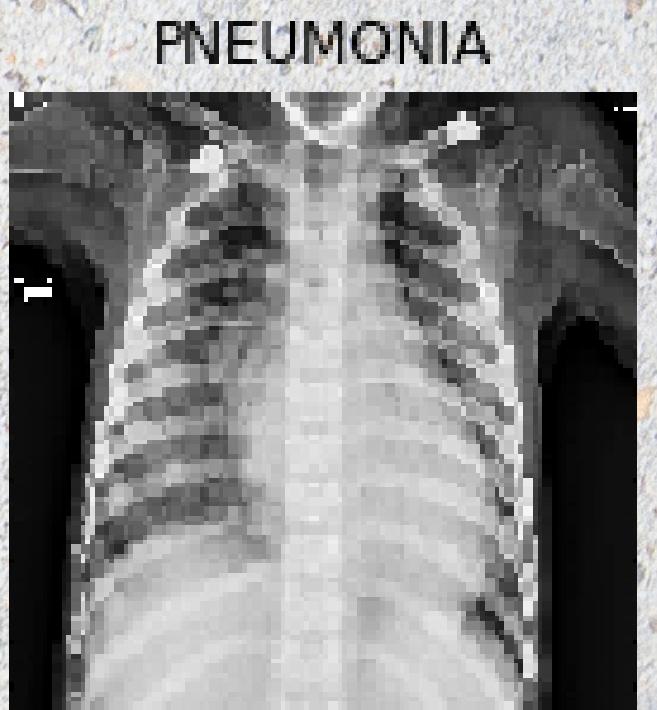
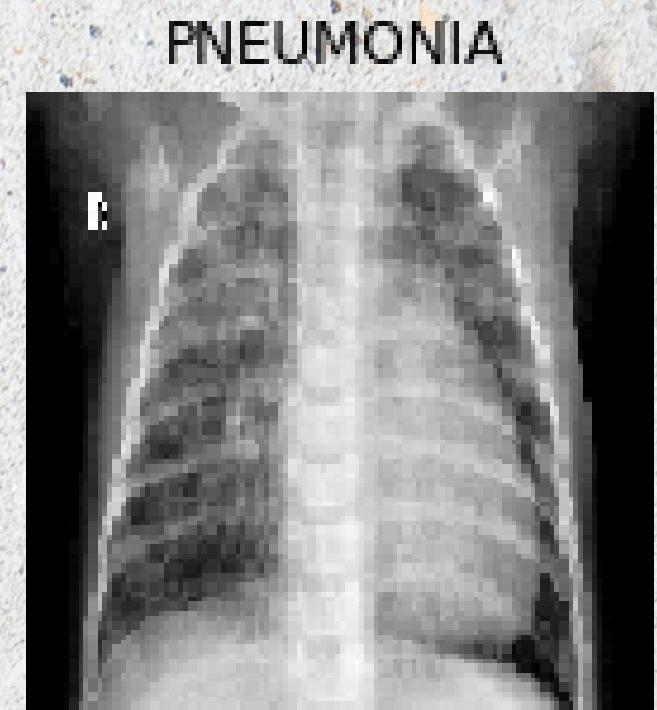
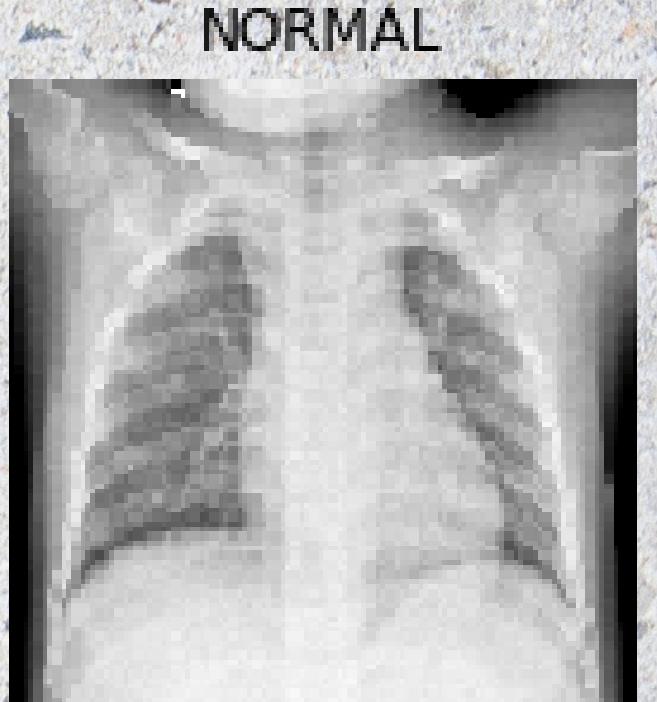
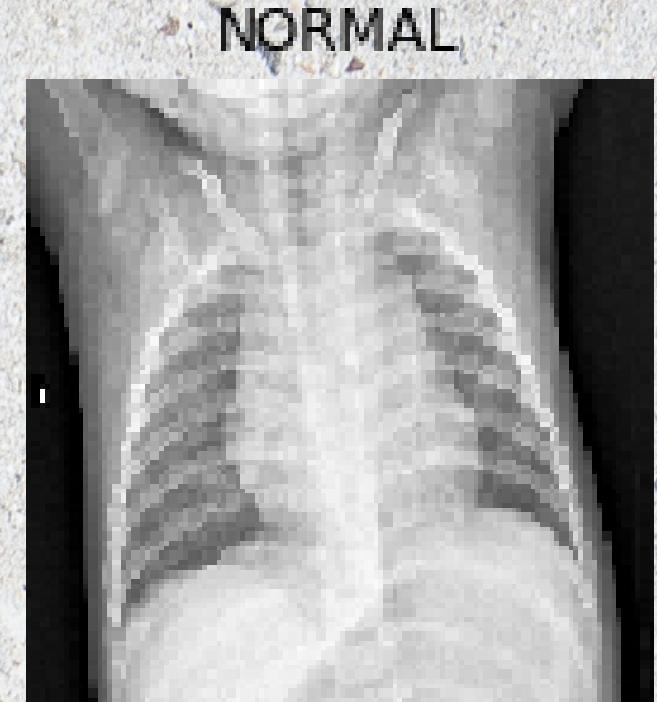
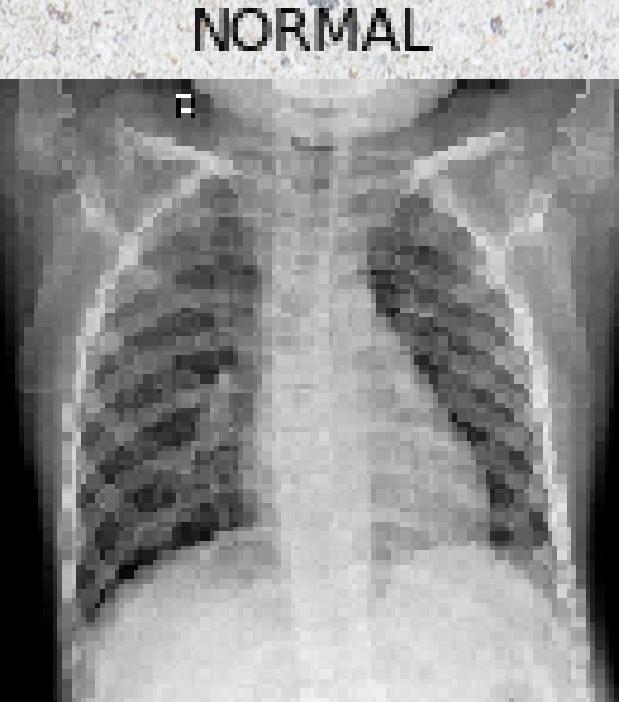
- 5,863 X-Ray images
- 1583 Healthy and 4280 with pneumonia
- Both Bacterial and Viral cases
- Chinese Pediatric Patients 1-5 years old

kaggle



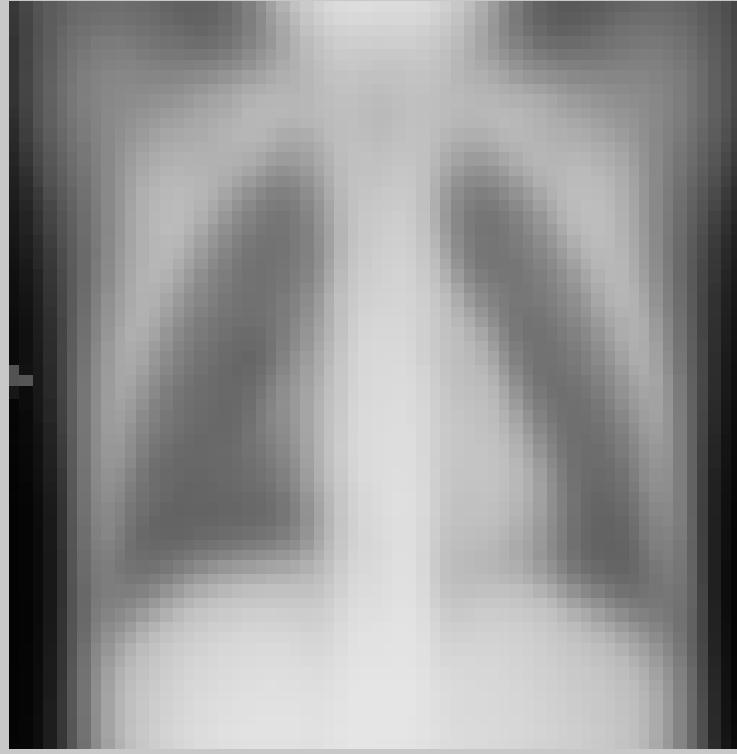
Exploratory Data Analysis

- Made visual comparisons
- Difference in overall cloudiness
- Difference in contour definition of chest cavity

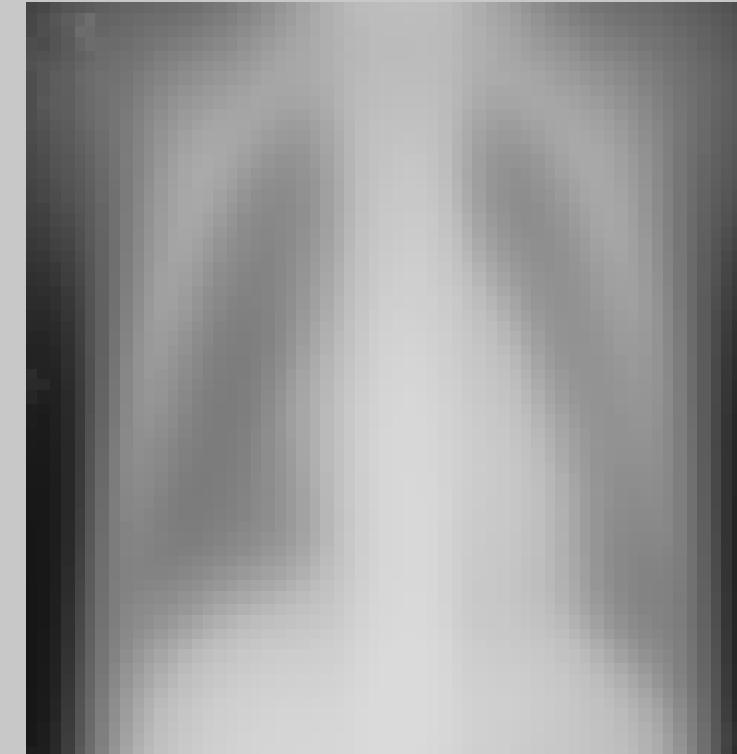


Comparing Standard Deviation and Average by Class

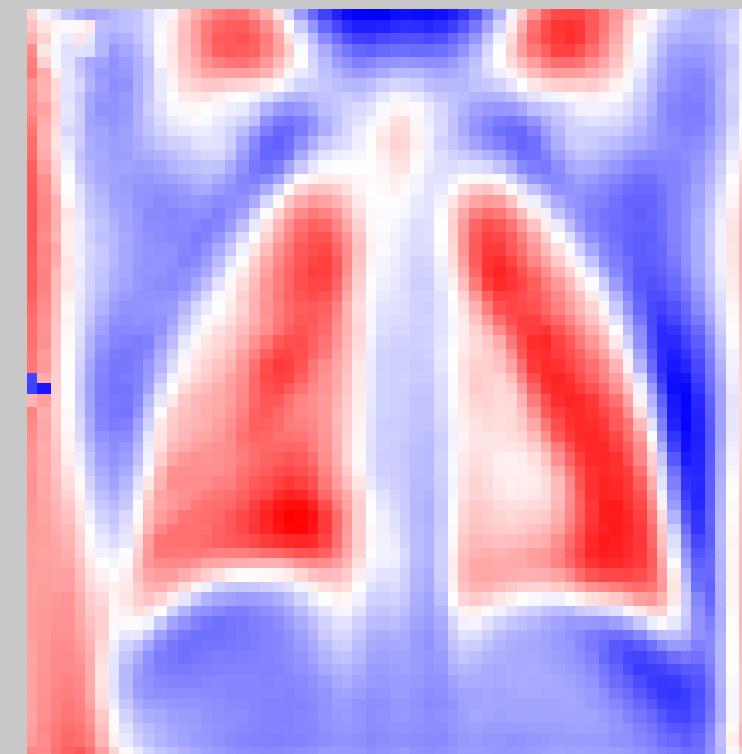
Average NORMAL



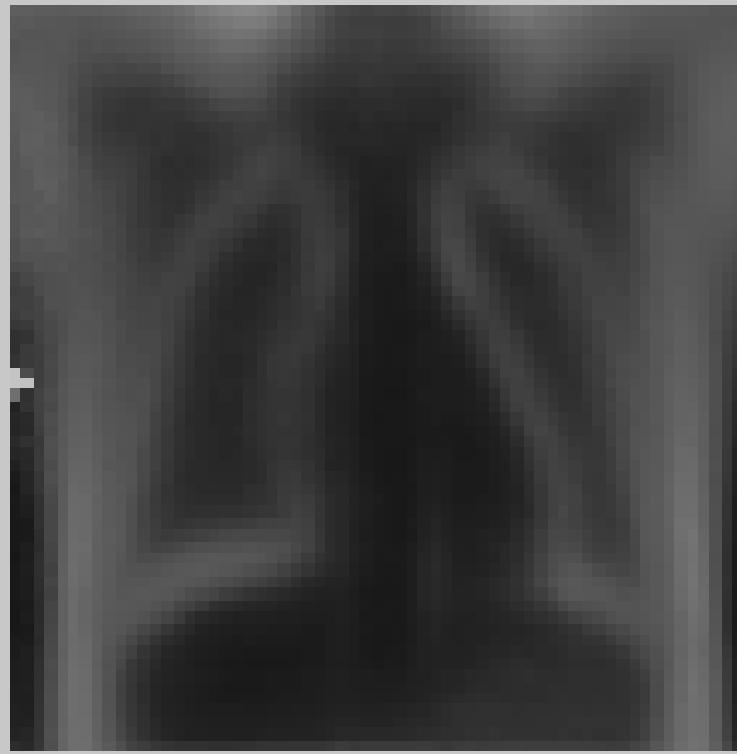
Average PNEUMONIA



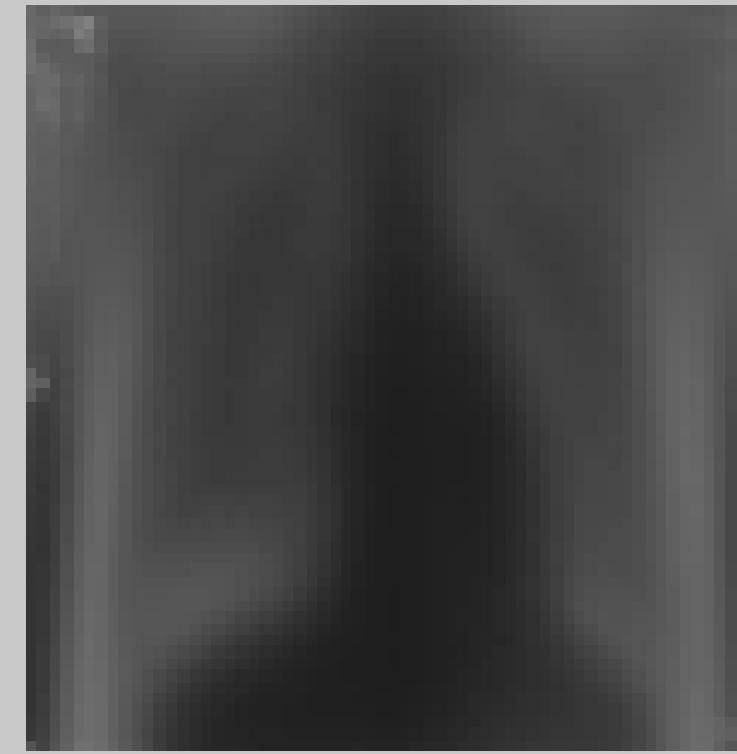
Difference Between Normal & Pneumonia Average



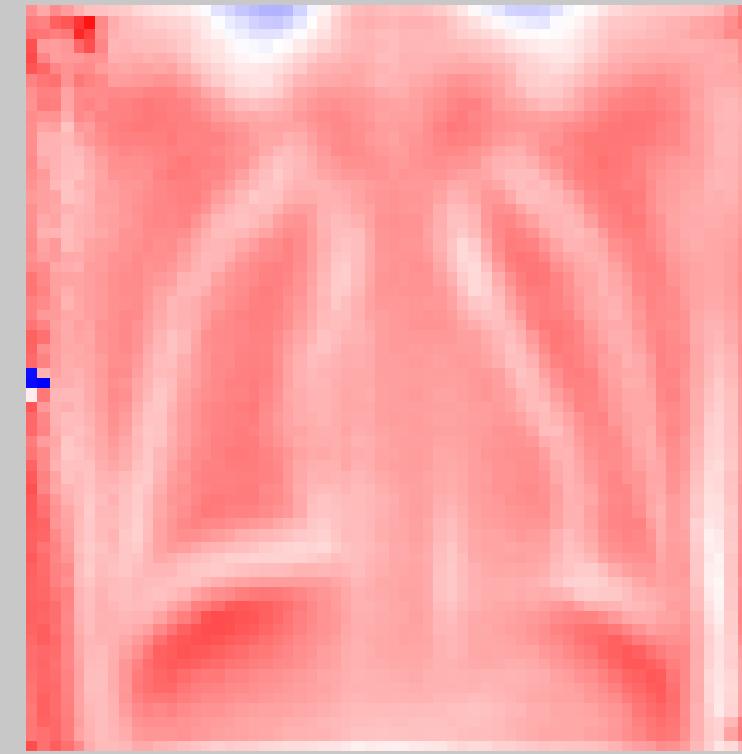
Standard Deviation NORMAL



Standard Deviation PNEUMONIA

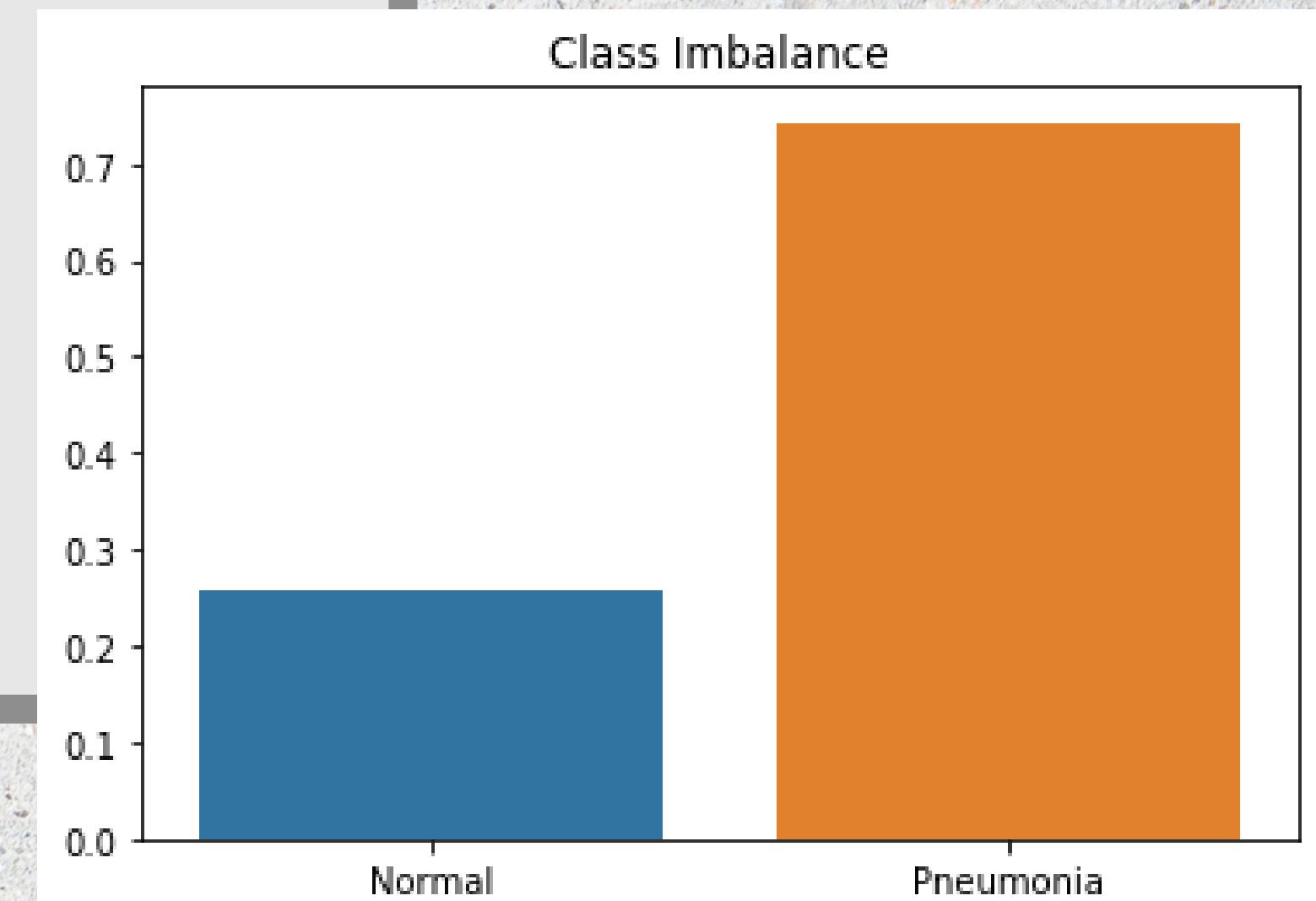


Difference Between Normal & Pneumonia Standard Deviation



Preprocessing and Augmentation

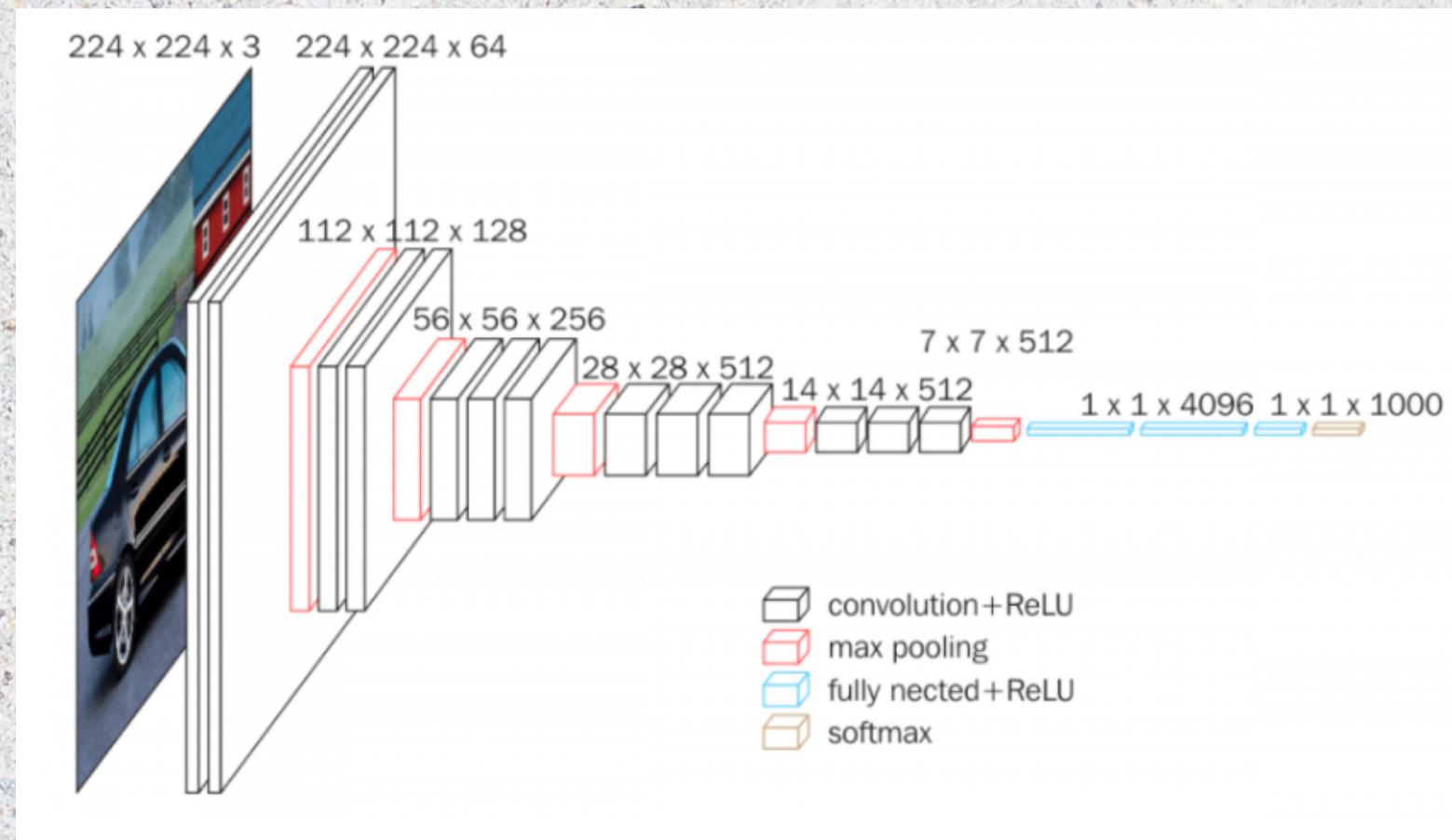
- Created inverse class frequency weights
- Augmented images with rotation and skew to upsample
- Resized to 224x224
- Used class weights in final models



Modeling with Transfer Learning

Created 4 CNN Models-

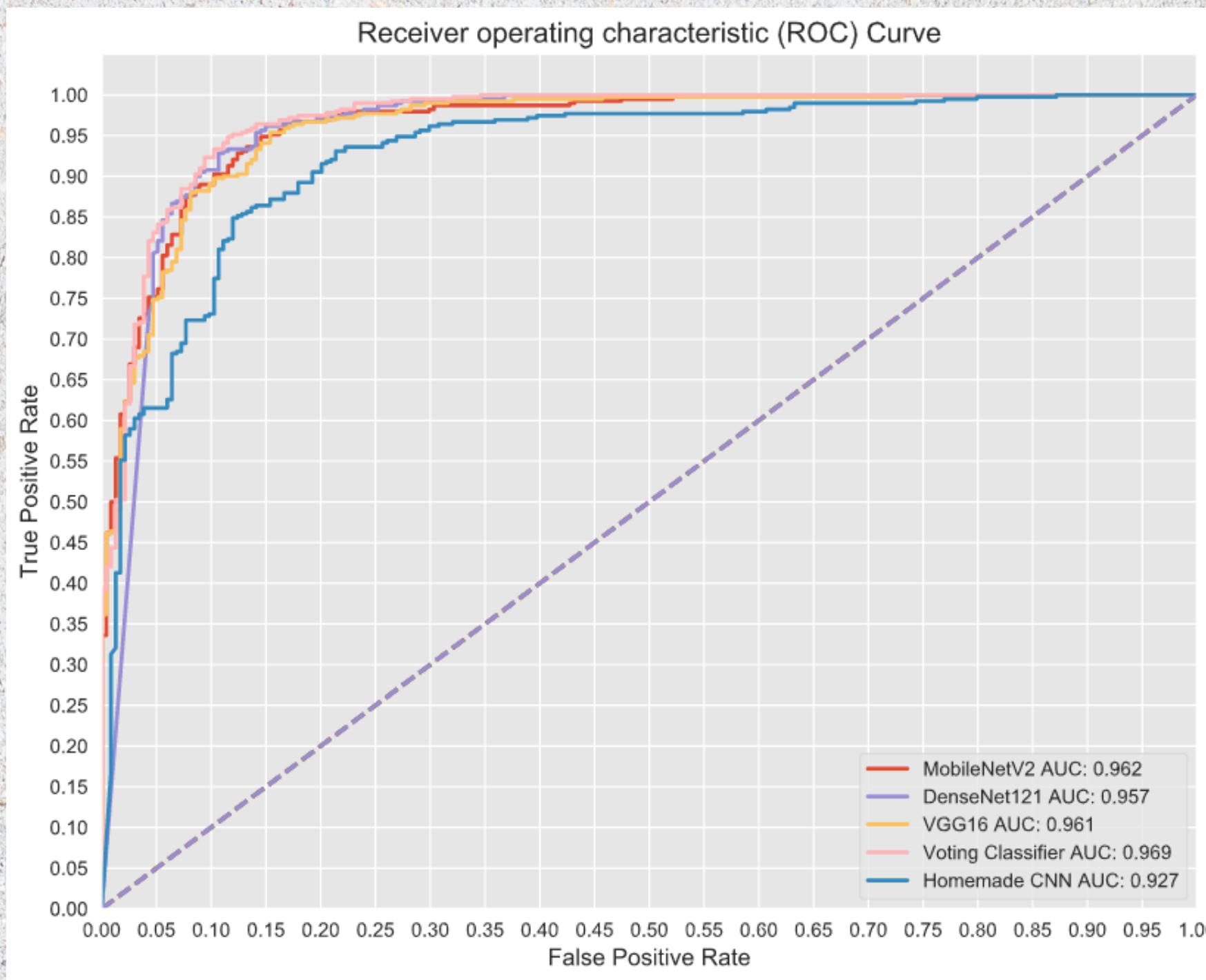
- 3 Pre-trained- VGG16, DenseNet121 and MobileNetV2
- 1 Homemade featuring 8 Convolutional layers and 4 Dense



Condensed into 1 Voting Classifier
1. Analyzed prediction distribution
to find best threshold

VGG16 architecture

Results



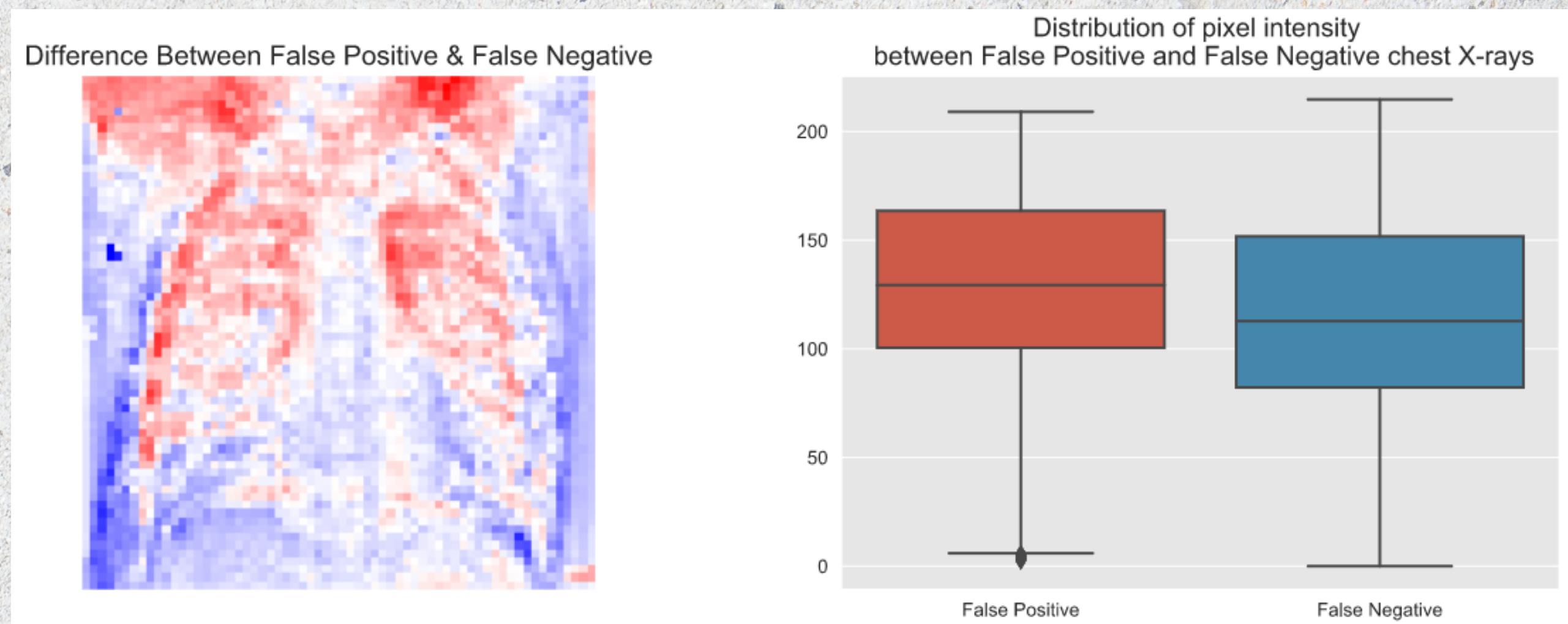
Voting Classifier achieved highest scores across metrics

- Recall: .99
- Accuracy: .90
- AUC: .97



Further Analysis

- Pulled False Positives and False Negatives and compared mean pixel intensity
- We believe our model could still improve with more training



Conclusions/Next Steps

- Models performed well, but could still improve
- MobileNet model could be utilized on older computers or a smartphone app
- Could divide pneumonia classes into Bacterial and Viral for further analysis
- Meta-Learning in our Ensemble Classifier could generate better predictions