Detecting Pneumonia in Chest Radiographs

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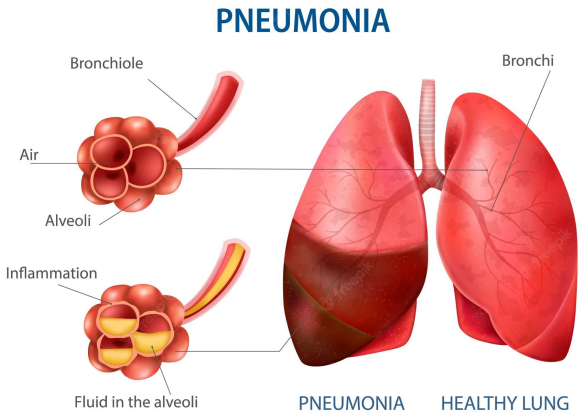
Outline

- The Problem
- Data
- Methods
- Results
- Conclusions

The Problem

According to the WHO, ***Pneumonia*:**

- Accounts for **14% of all deaths of children under 5**
- **Can be prevented**, but only **one third** of children who have it **receive the antibiotics they need**
- **Can be prevented** with simple interventions
- **Can be treated** with low-cost, low-tech medication/ care
- **<u>Killed 740,180 children in 2019</u>**



- That means **488,518 of those children** needed **proper treatment**, which requires **accurate diagnosis**

The Problem

- **Médecins Sans Limites (MSL)**, an AI-based medical research company, hopes to use **Convolutional Neural Networks** to identify patients with pneumonia based on **Chest Radiographs**

- We have created a **Convolutional Neural Network** that can **help save hundreds of thousands of lives per year**

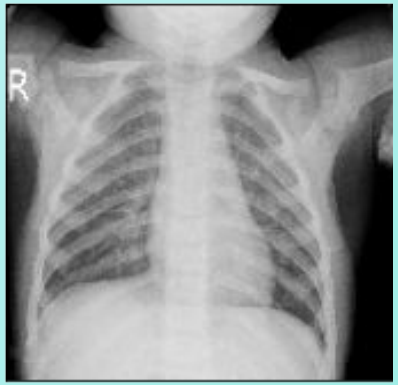
Data - Chest Radiographs

- 5,863 Total Images
- X-Rays from pediatric patients 1-5 years old
- Classes reduced to 2:
  - NORMAL (1,583 x-rays)
  - PNEUMONIA (4,280 x-rays)

Data

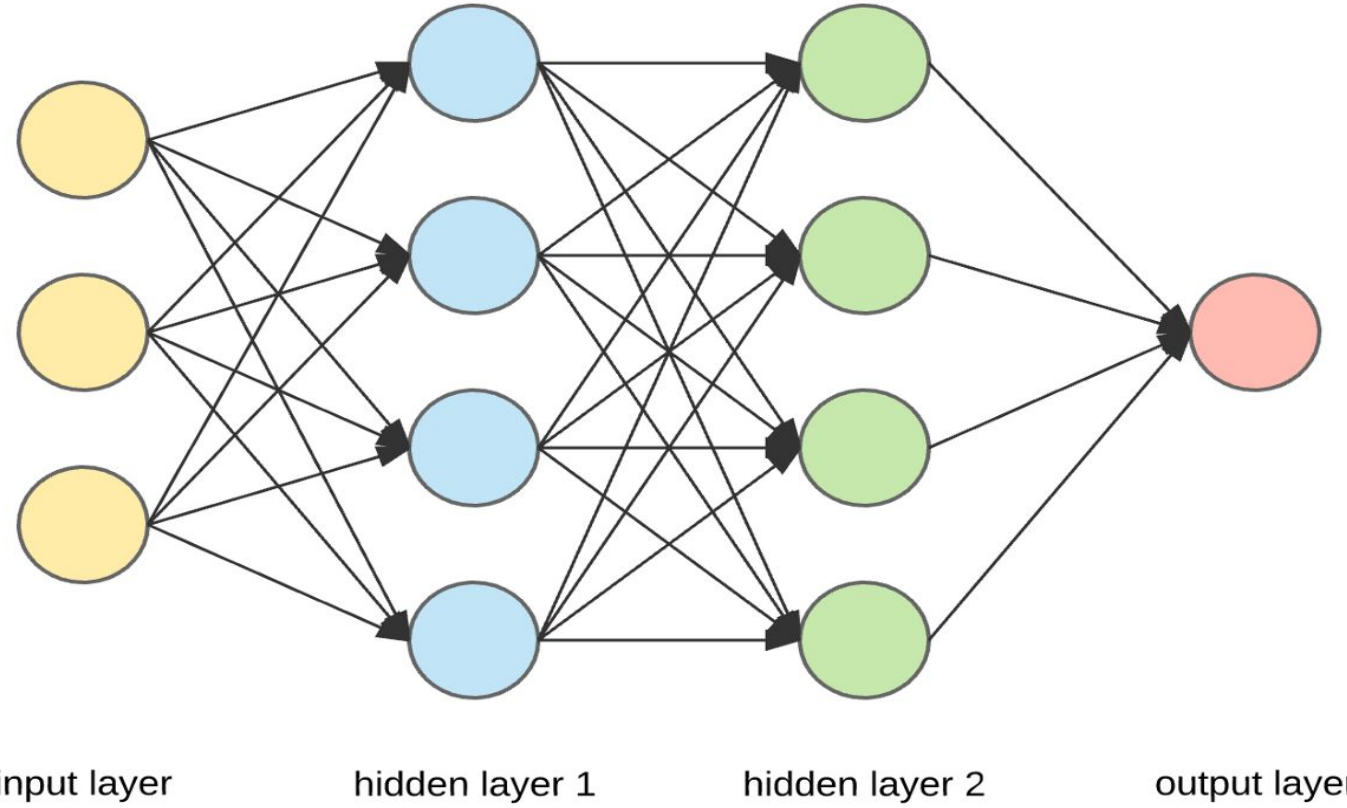
- Not easy to distinguish by eye
- Requires Trained Medical Professionals

NORMAL

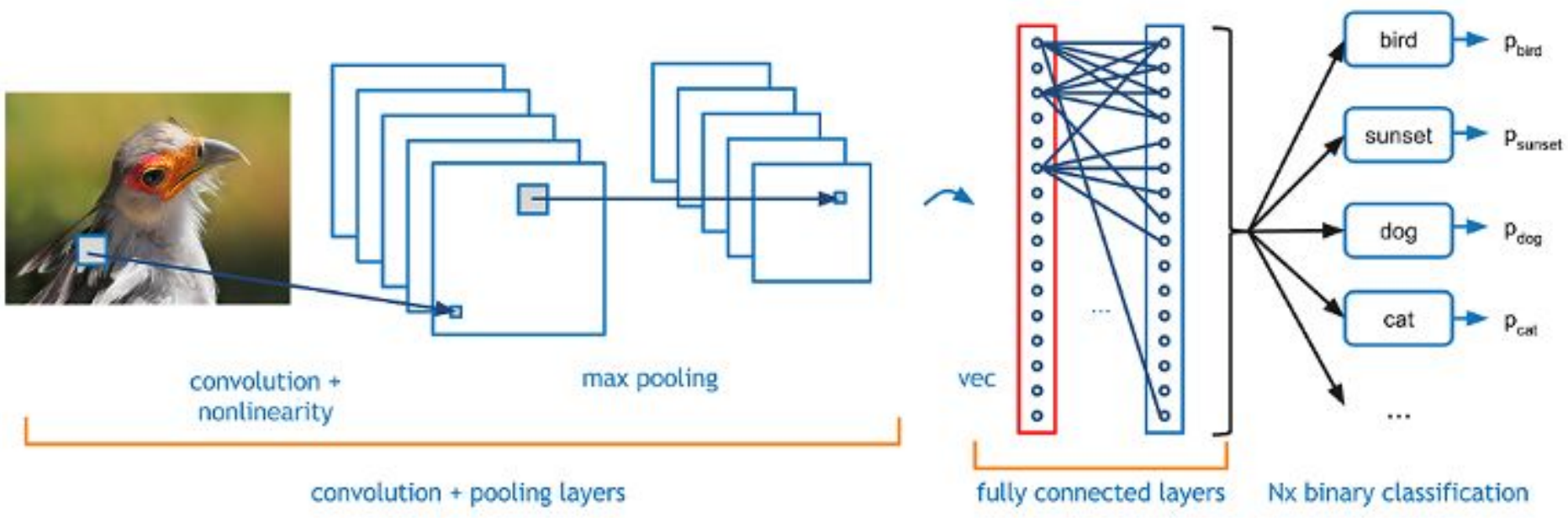


PNEUMONIA

Methods - Deep Learning Neural Networks



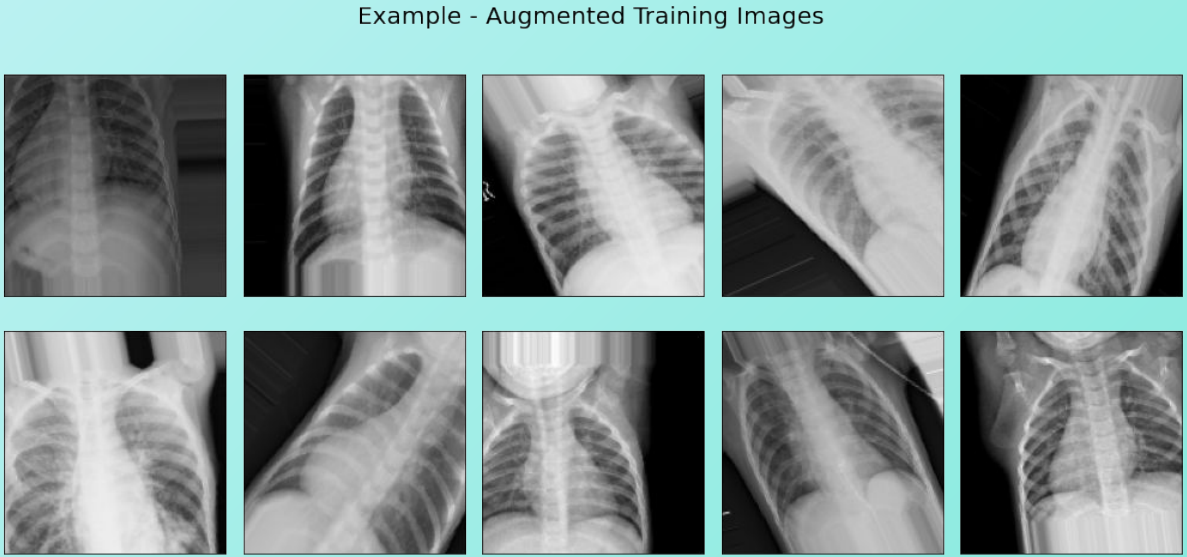
Methods - Convolutional Neural Network



Methods - Data Augmentation

Training images were randomly altered:

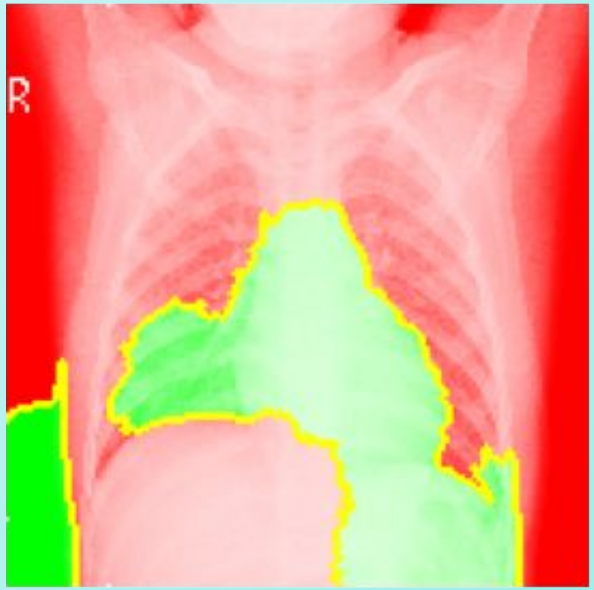
- Rotation
- Width
- Height
- Zoom
- Shear



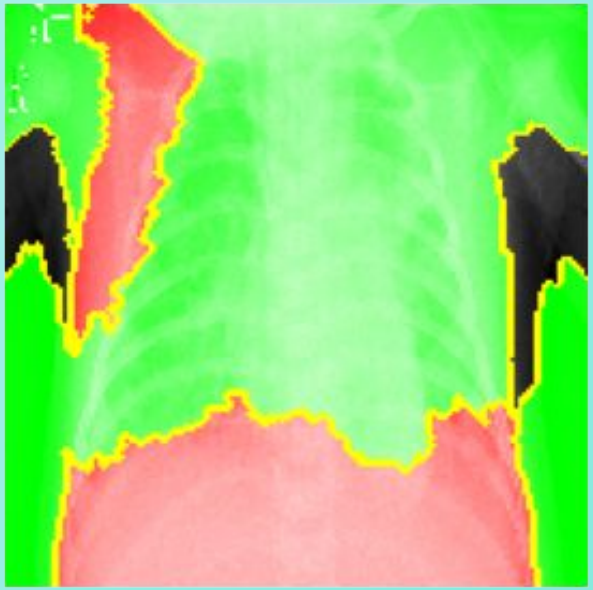
Methods - Understanding Model Prediction

★ **Green indicates potential patterns indicating pneumonia**

NORMAL



PNEUMONIA



Results - Baseline Model

Accuracy:

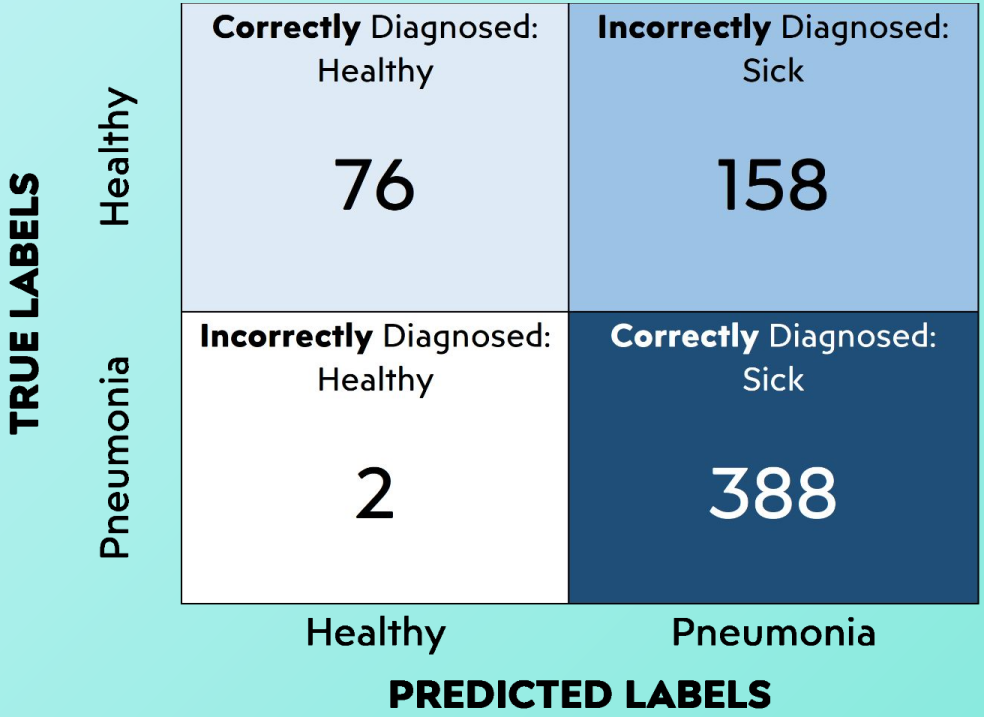
Percentage of *successful predictions* by the model:

74%

Sensitivity:

Percentage of sick patients *successfully identified*:

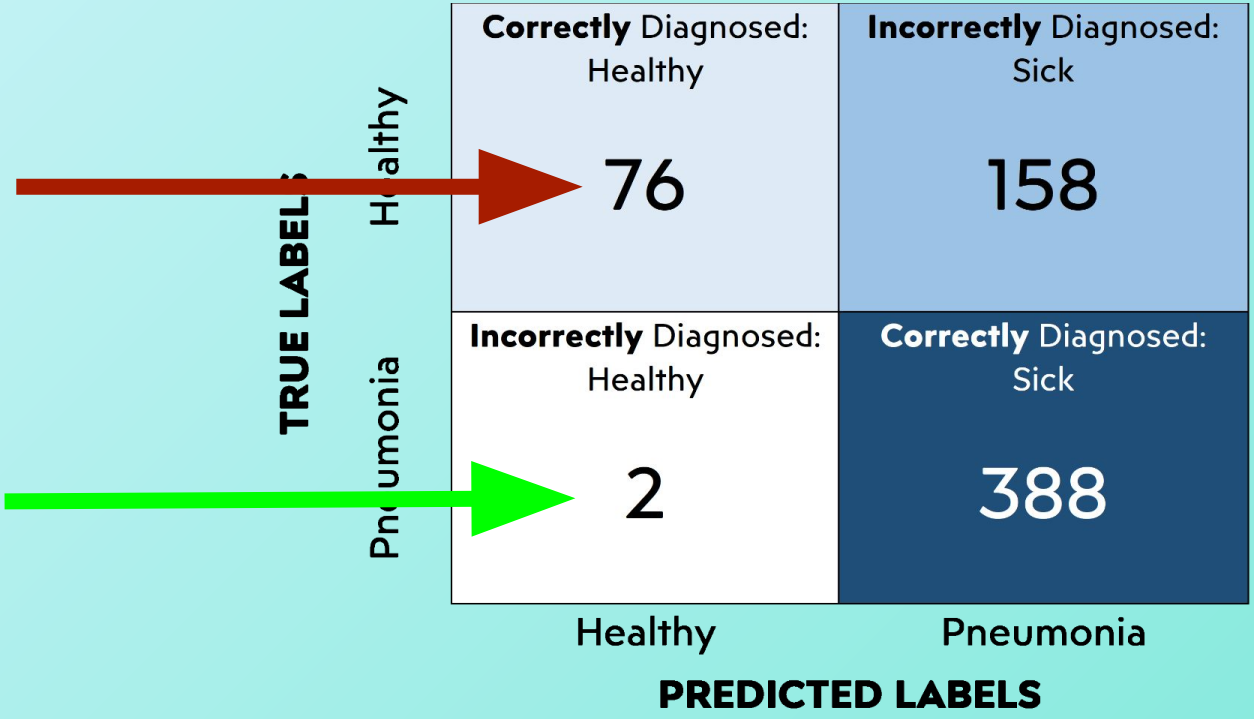
99%



Results - Baseline Model

TRUE NEGATIVES
Too Low, needs to be more accurate!

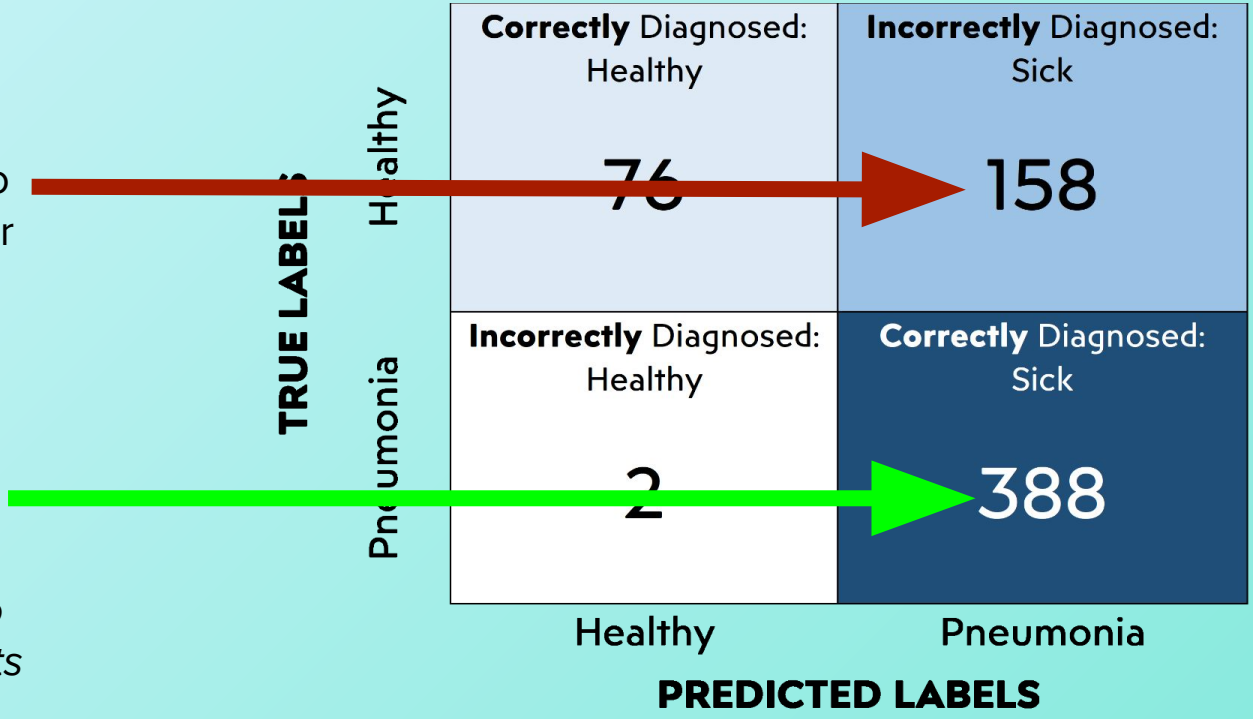
FALSE NEGATIVES
We want to **make sure this stays low**. The lower it is, the more potential **lives can be saved!**



Results - Baseline Model

FALSE POSITIVES
Too High, could lead to *untrustworthy results* or *waste of resources*

TRUE POSITIVES
Many Accurate Diagnoses, but only because model *fails to predict healthy patients most of the time*



Results - Final Model

Accuracy:

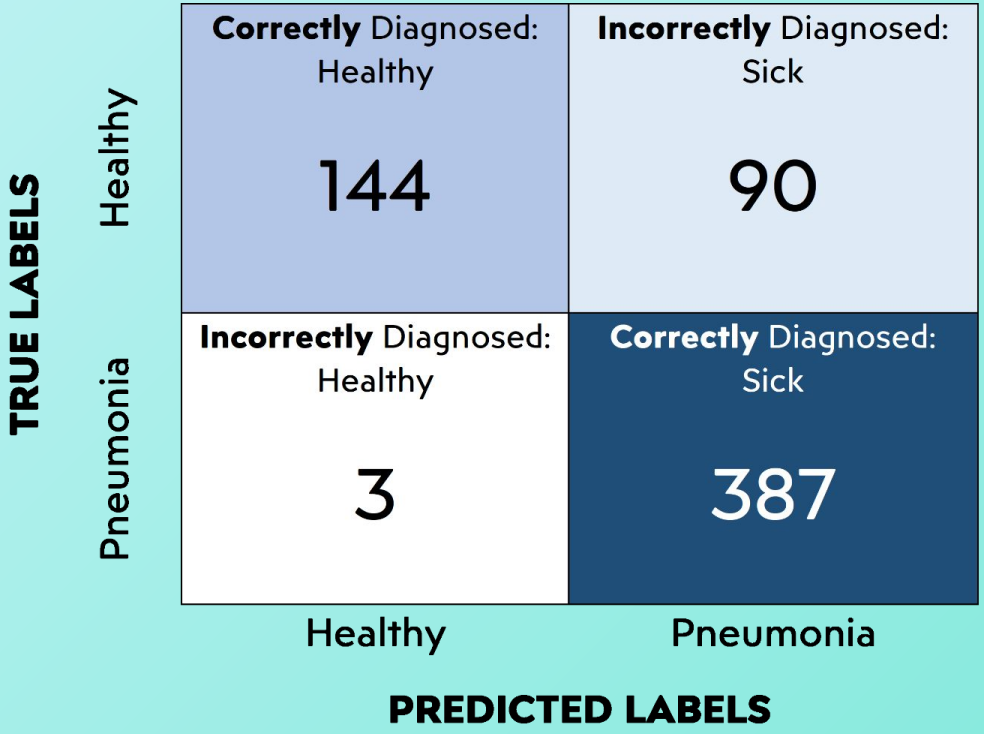
Percentage of *successful predictions* by the model:

85%

Sensitivity:

Percentage of sick patients *successfully identified*:

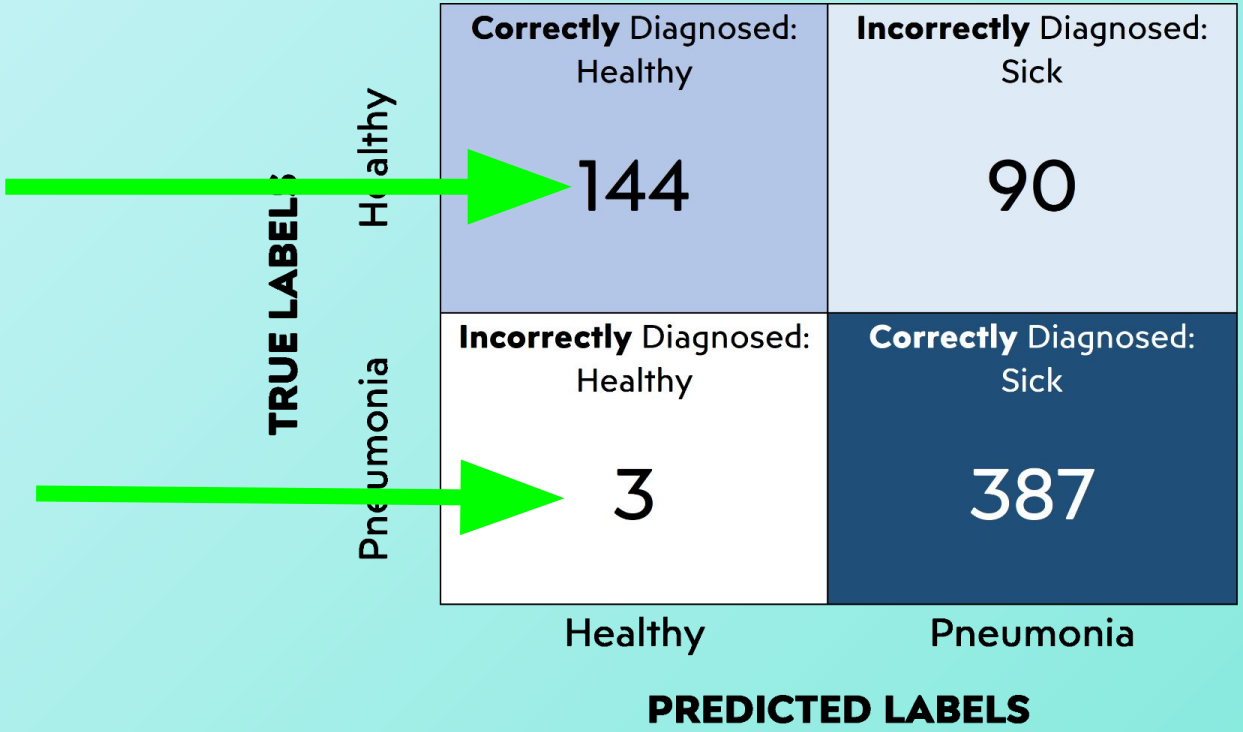
99%



Results - Final Model

TRUE NEGATIVES
More Correct Healthy Diagnoses, prevents unnecessary use of resources

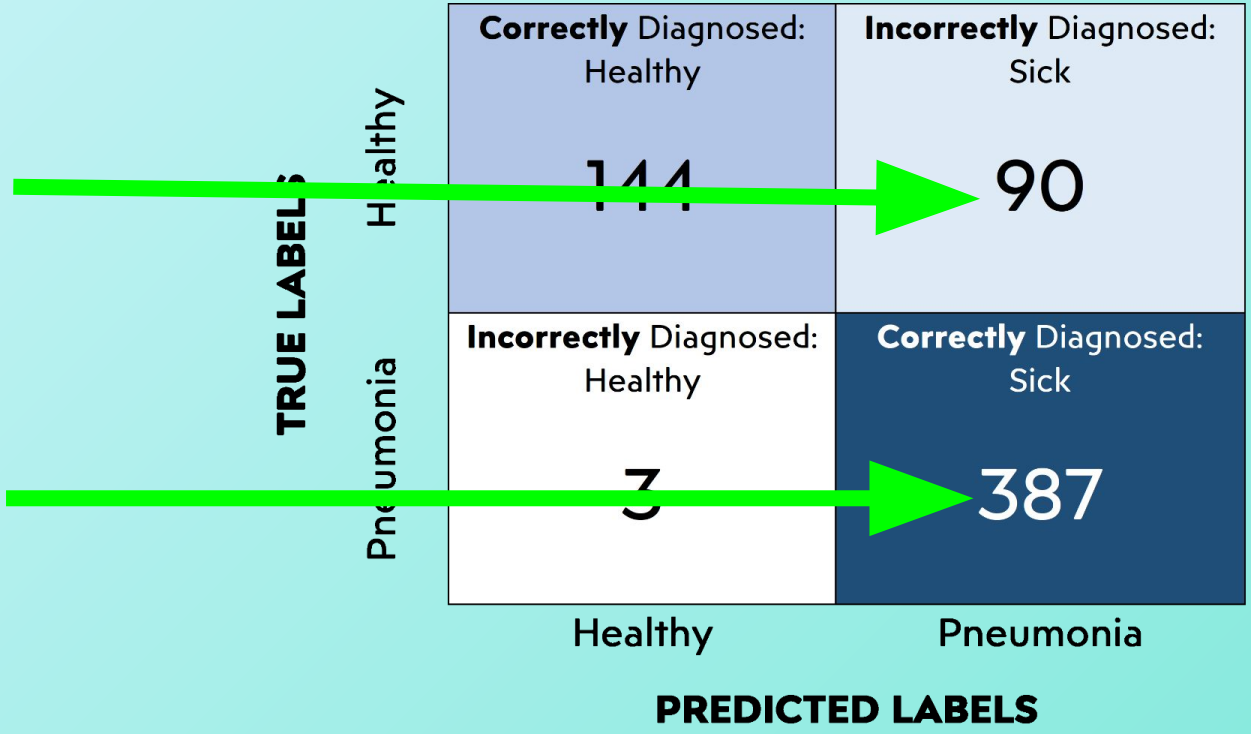
FALSE NEGATIVES
Very Few patients misdiagnosed as Healthy, leading to **more lives saved**



Results - Final Model

FALSE POSITIVES
Significantly Lower, Leading to *higher accuracy* and *less waste of resources*

TRUE POSITIVES
Maintains Accurate Sick Diagnoses while also *increasing accuracy of healthy diagnoses*



Conclusion

- Model predicts Positive cases of Pneumonia with **85% accuracy** while **maintaining 99% sensitivity, preventing unnecessary loss of life**
- Equates to **over 483,000 lives potentially saved each year**
- Can help **easily identify pneumonia** so that children in need have access to **low cost, life saving care**

Next Steps

- Deploy Neural Network model along with **easy-access, affordable care** to regions in need
- **Additional data collection** for further fine tuning to increase performance
- Adjust model for **wider demographic** of patients, such as different age groups
- Create classifiers that can identify **multiple illnesses**, or multiple degrees of illness

Thank you

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