Convolutional Neural Networks For Detection Of Pneumonia in Chest X-Ray Images

Jonah Devoy

Who Are you?

A Health care system who wants to invest in artificial intelligence in medical imaging. Your aim is to hire a data scientist (Me) who can construct a machine learning model capable of categorizing chest x-ray images in their radiology department, distinguishing between pneumonia and non-pneumonia cases, ultimately enhancing departmental efficiency and workflow. As a solution, I developed a Convolutional Neural Network that addresses this challenge, enabling you (healthcare system) to optimize their radiology operations.

Pneumonia

What is it?

Pneumonia, a severe infection, occurs when bacteria, viruses, or fungi infect one or both lungs, resulting in the accumulation of pus and other fluids in the air sacs.

Causes

Pneumonia usually occurs when the body is weakened by illness, poor nutrition, old age, or impaired immunity, allowing bacteria to invade the lungs. Certain conditions, like alcohol abuse, smoking, debilitation, recent surgery, respiratory illness, viral infection, or a weakened immune system, increase the risk of bacterial pneumonia.

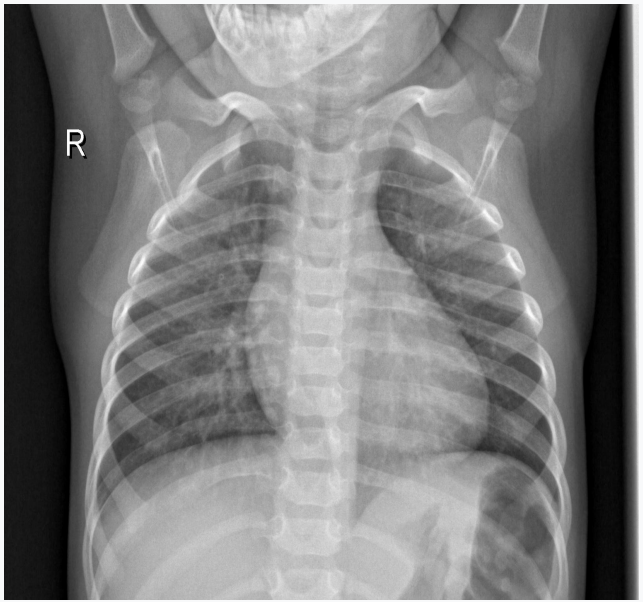
Diagnosed by:

- Chest X-Ray
- Blood Tests
- Sputum culture
- Bronchoscopy
- Pleural fluid culture

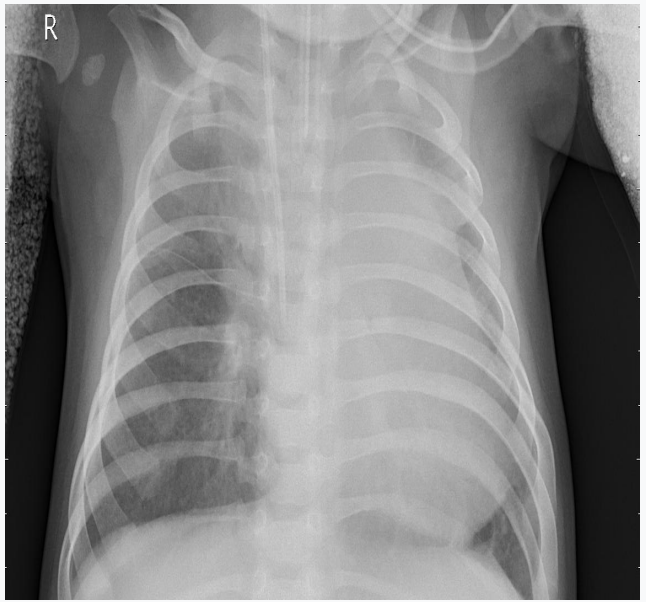
Most people with pneumonia respond well to treatment, but pneumonia can cause serious lung and infection problems. It can even be deadly.

X-Ray Images

Normal



Infected

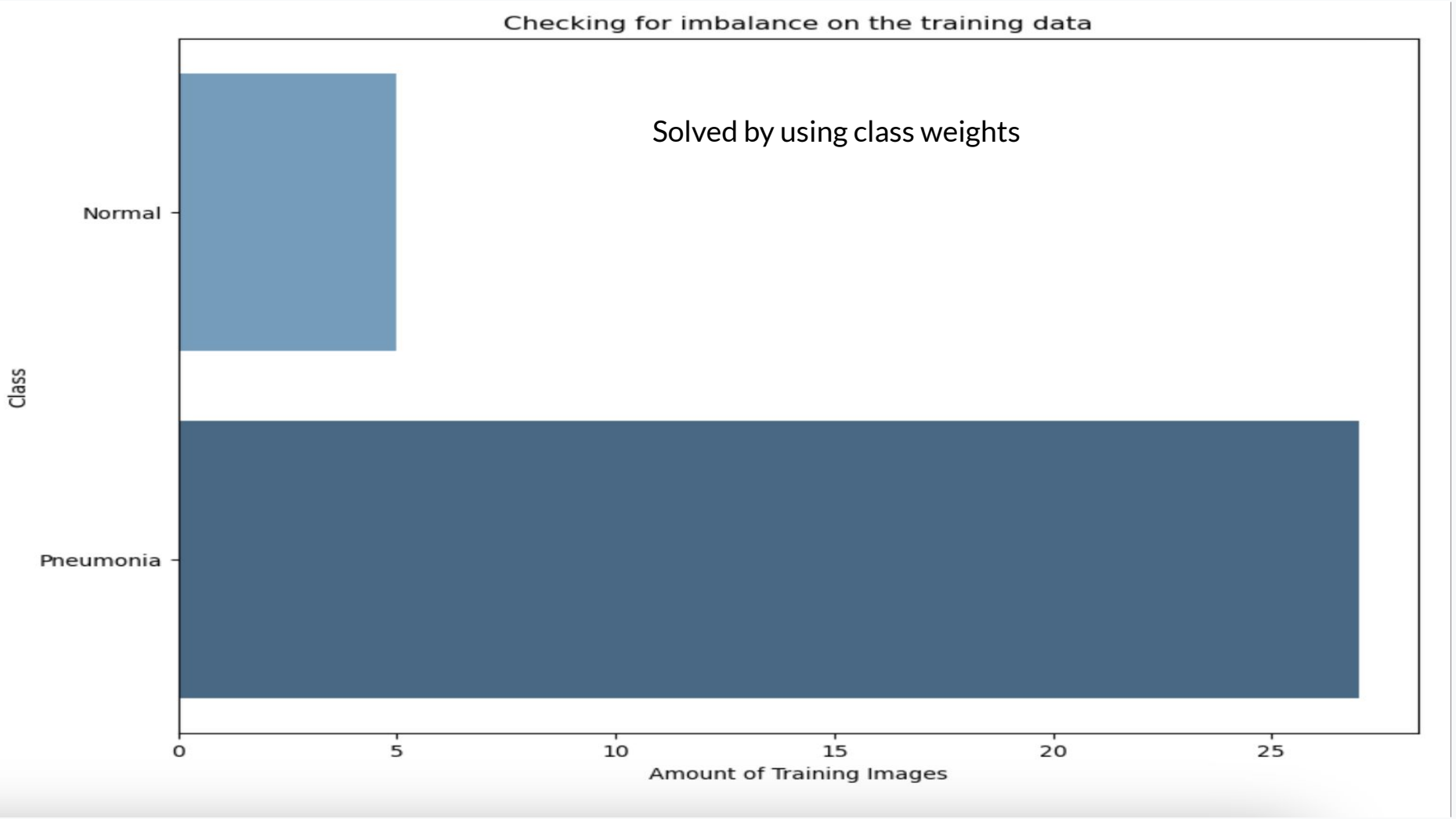


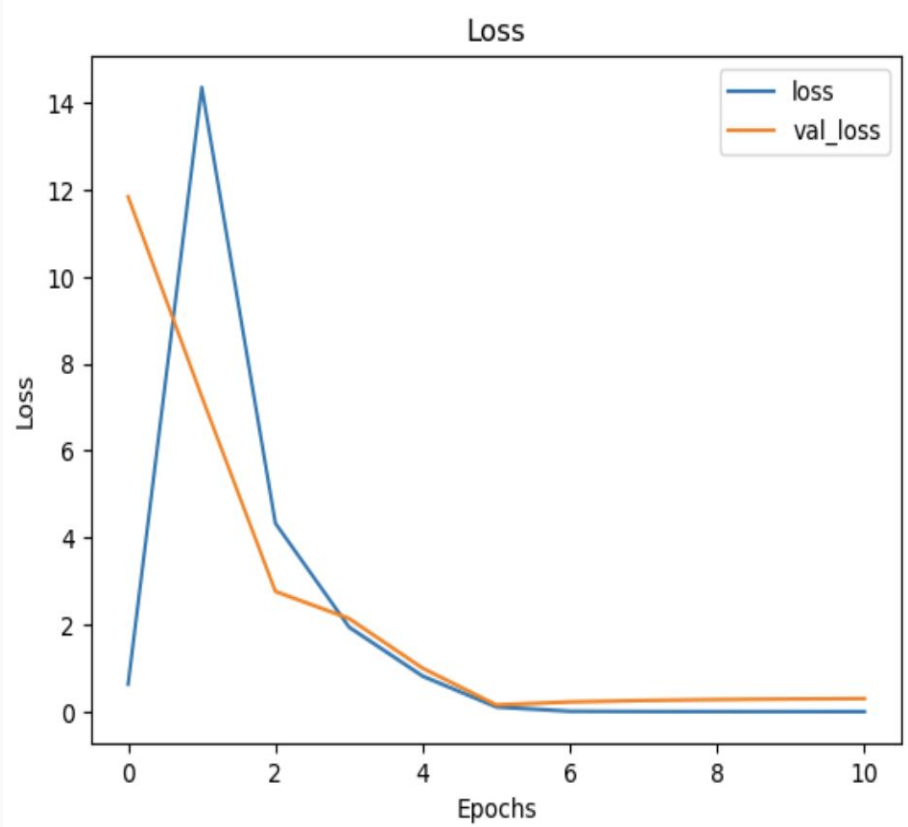
Defining a Convolutional Neural Network

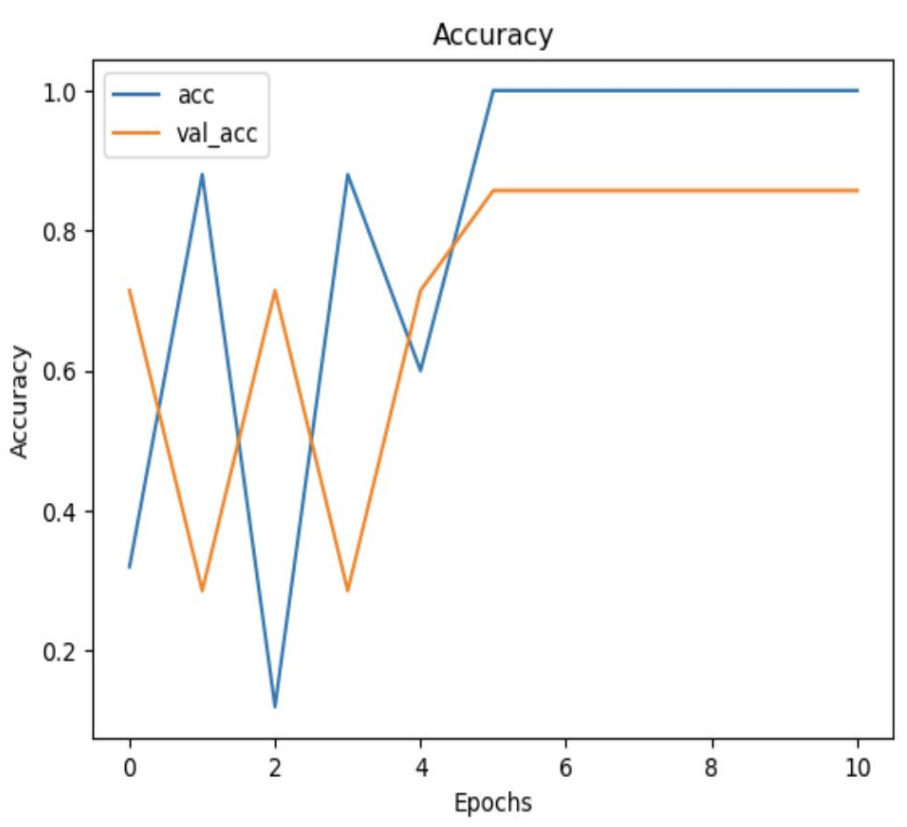
- Convolutional Neural Networks (CNNs) are AI algorithms inspired by human vision that analyze and understand visual information.
- CNNs use interconnected layers to process data, gradually extracting higher-level features and patterns.
- CNNs automatically learn and recognize visual patterns through training on large datasets.

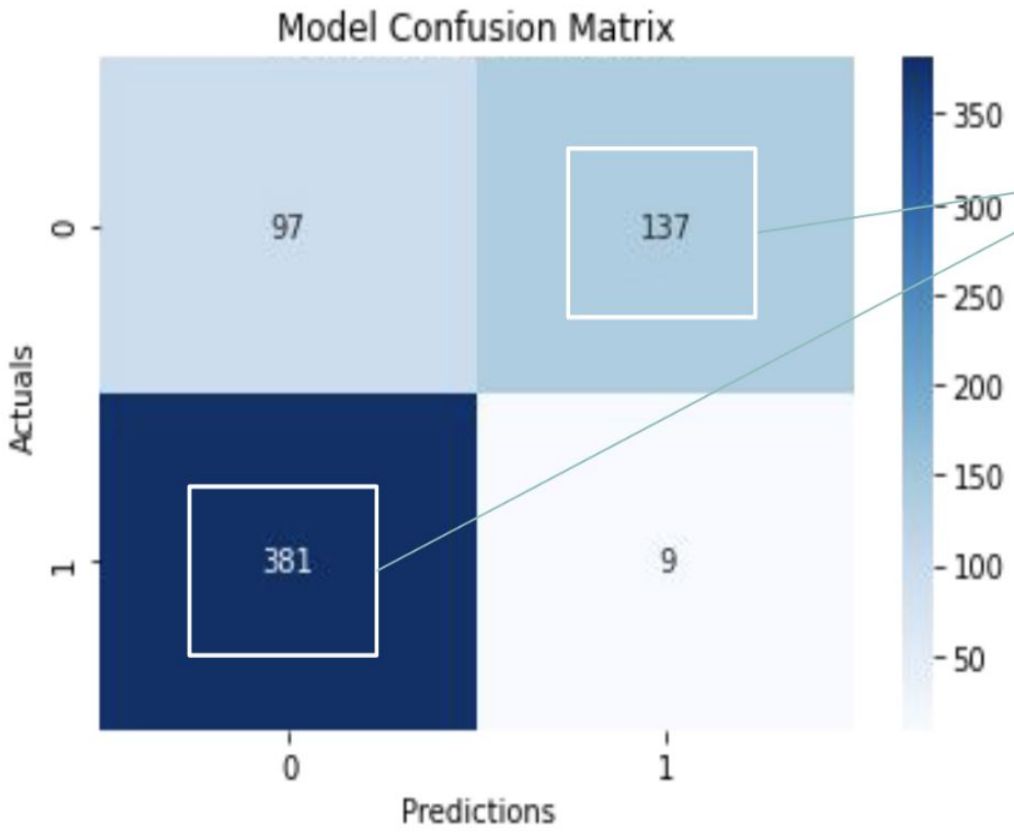
- CNNs are used in image recognition, object detection, and classification, with applications in autonomous vehicles, surveillance, and medical imaging.
- CNNs utilize convolution to extract relevant features from local regions of input data.

- CNNs capture both low-level and high-level visual information, making them powerful tools in computer vision.


Checking for imbalance on the training data
Solved by using class weights
Normal
Pneumonia
Class
0
5
10
15
20
25
Amount of Training Images


Loss
loss
val_loss
Loss
Epochs
0
2
4
6
8
10
0
2
4
6
8
10
12
14


Accuracy
acc
val_acc
Accuracy
Epochs
0
2
4
6
8
10
0.2
0.4
0.6
0.8
1.0

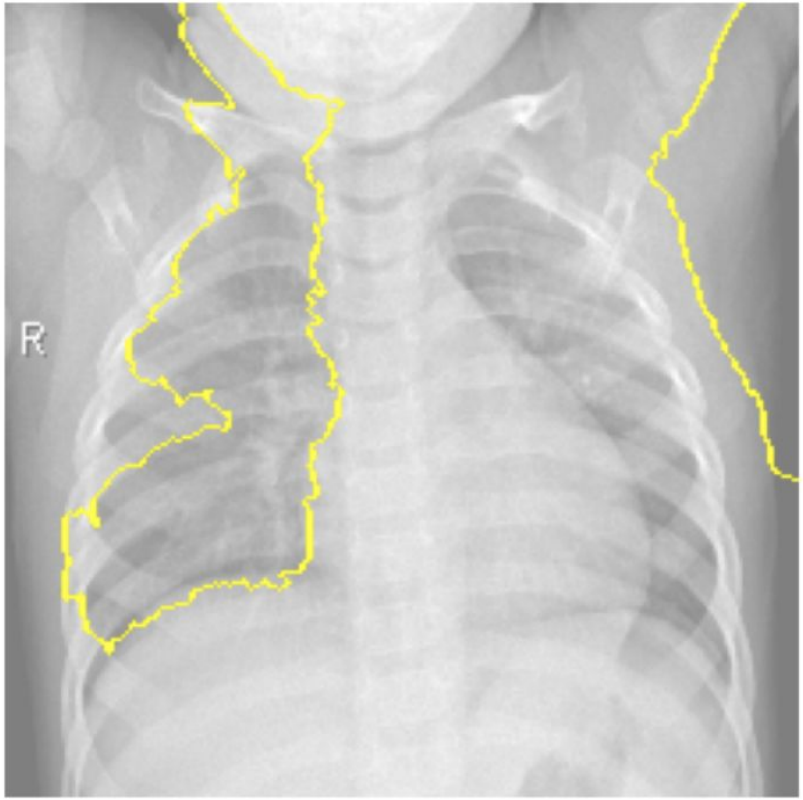


*We want to reduce False Negatives, and False Positives

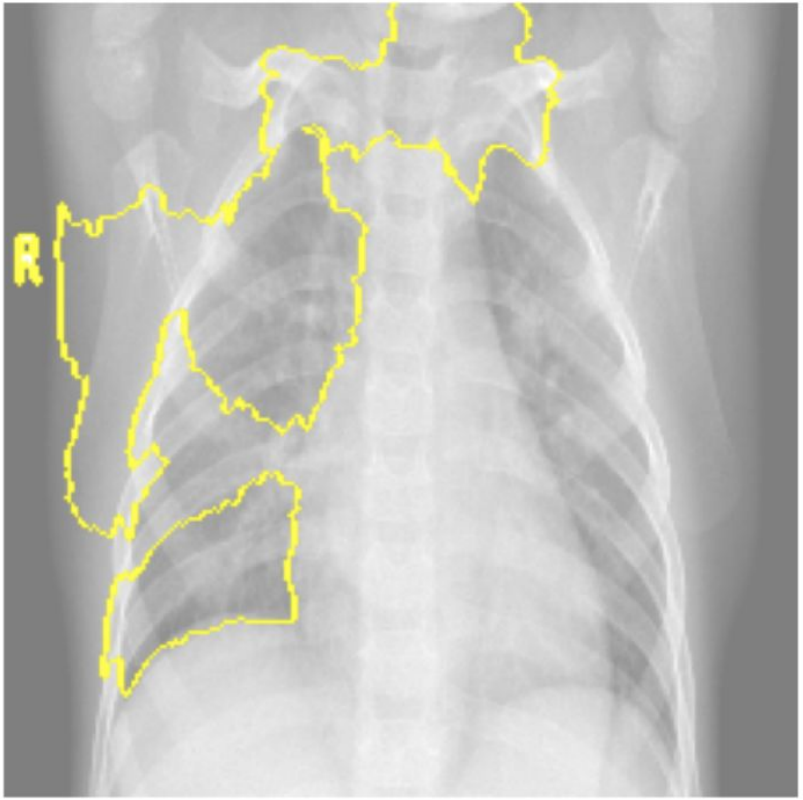
90% Accuracy Score

- TP: Correctly predicted positive instances.
- FP: Incorrectly predicted positive instances.
- TN: Correctly predicted negative instances.
- FN: Incorrectly predicted negative instances.

Correct Normal Classification



Incorrect Pneumonia Classification



Recommendations

- Implementing this model in a radiology setting can optimize pneumonia detection by automatically providing predictions upon capturing a chest x-ray, reducing the time needed for technicians and doctors to review the model's output and allowing them to prioritize their expertise in making final diagnoses, thus improving departmental efficiency and enabling greater focus on other responsibilities.
- For improved model performance, it is recommended that x-ray technicians exclude the diaphragm from the image prior to inputting it into the model, aiming to minimize noise interference.
- Furthermore, it is advised that x-ray technicians resize the images to 224x224 pixels before utilizing them as input for the model or use further image augmentation

Thanks

Do you have any questions?

Jonah.devoy@yahoo.com

2398982549

www.linkedin.com/in/jonahdevoy