Interpretable Deep Learning (AI) for

Pneumonia Detection in Chest X-Rays

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Data Set Source

The dataset used in this project was downloaded from a publicly available GitHub repository. It originates from the NIH Chest X-ray dataset and has been curated for binary classification: Pneumonia vs Normal. It's widely used in academic and clinical machine learning research.

The dataset is organized into three folders: train, val, and test, each containing chest X-ray images labeled as either 'Pneumonia' or 'Normal'. There are 5,216 training images, 16 validation images, and 624 test images.

Problem Statement

- Detecting pneumonia from chest X-ray images is critical for timely treatment, especially in low-resource settings where radiologist availability is limited. Manual examination is time-consuming and prone to human error. This project automates pneumonia detection using deep learning to improve diagnostic efficiency, accuracy, and interpretability.

Dataset

- NIH Chest X-ray Dataset
- 100,000+ labeled images across 14 disease categories
- Publicly available and widely used in medical imaging research
- Includes pneumonia cases

Proposed Techniques

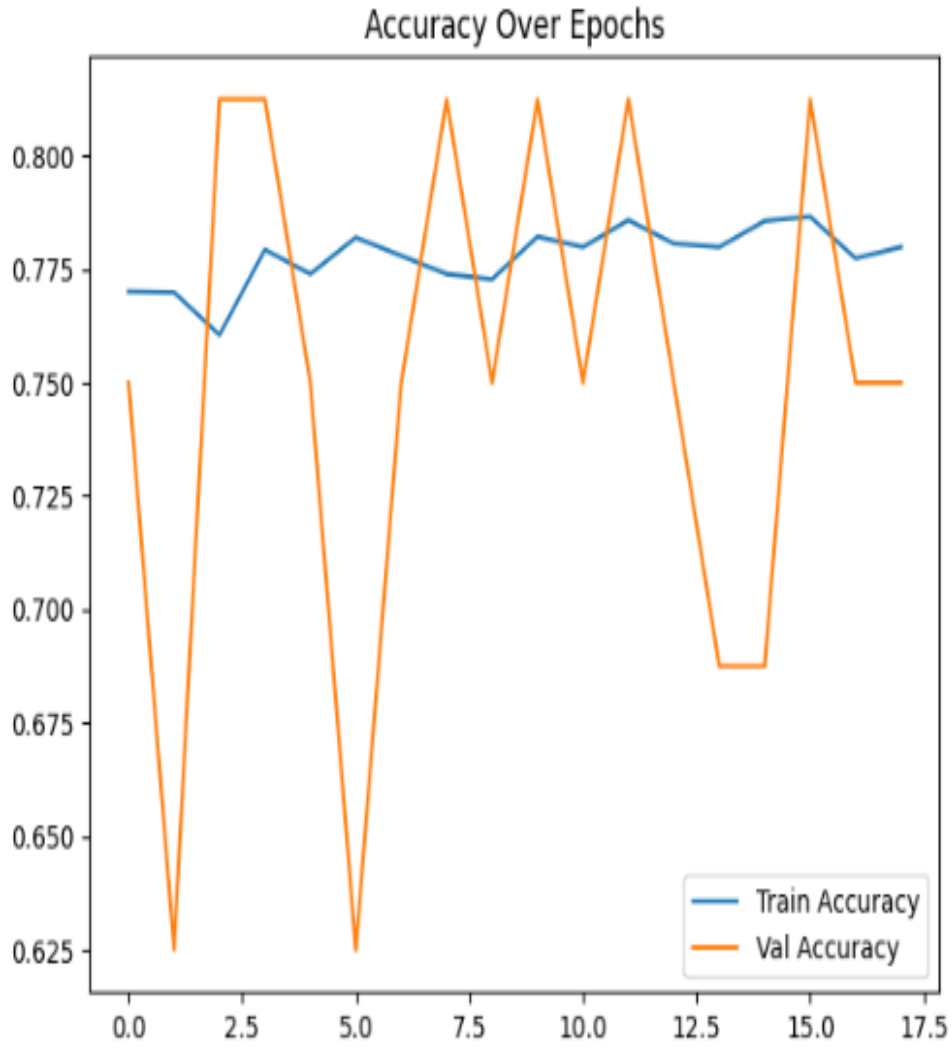
- Convolutional Neural Networks (CNNs) with Transfer Learning
- Pre-trained ResNet50 model fine-tuned for pneumonia detection
- Implemented using TensorFlow and Keras
- Grad-CAM visualizations for model interpretability

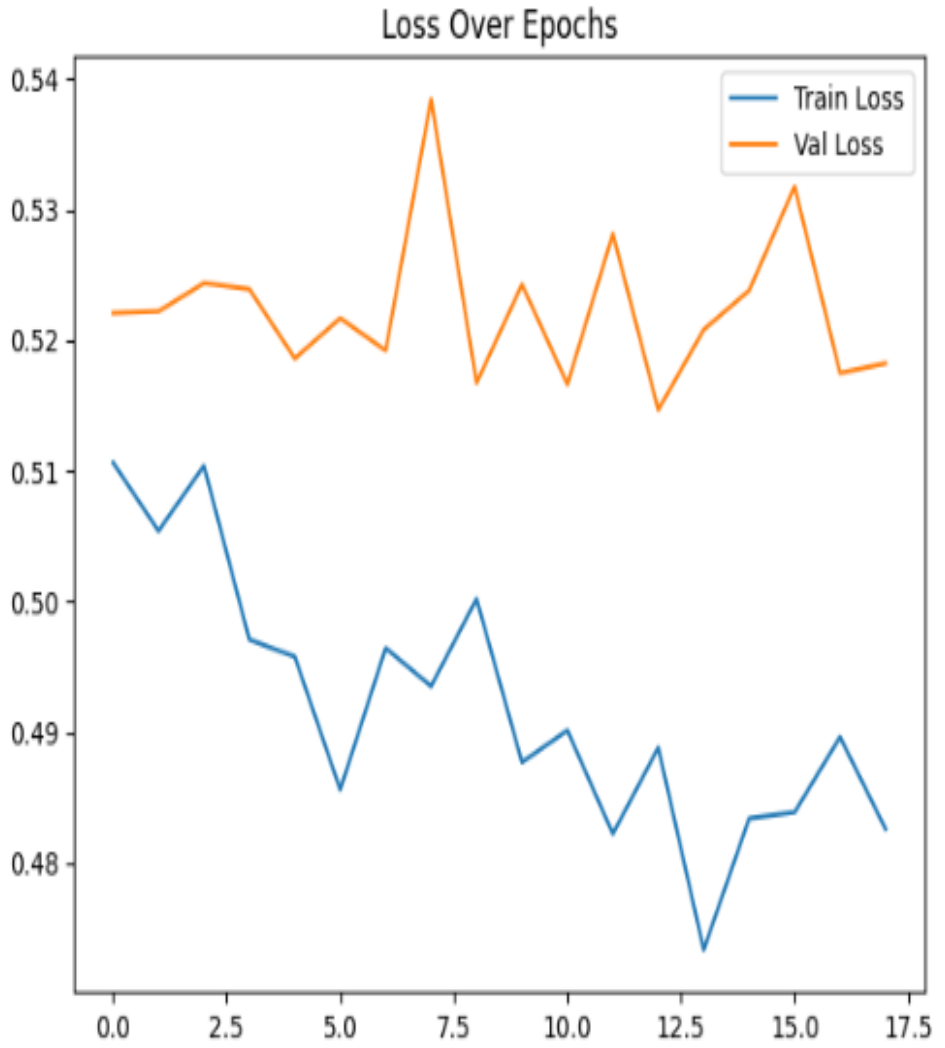
Project Steps

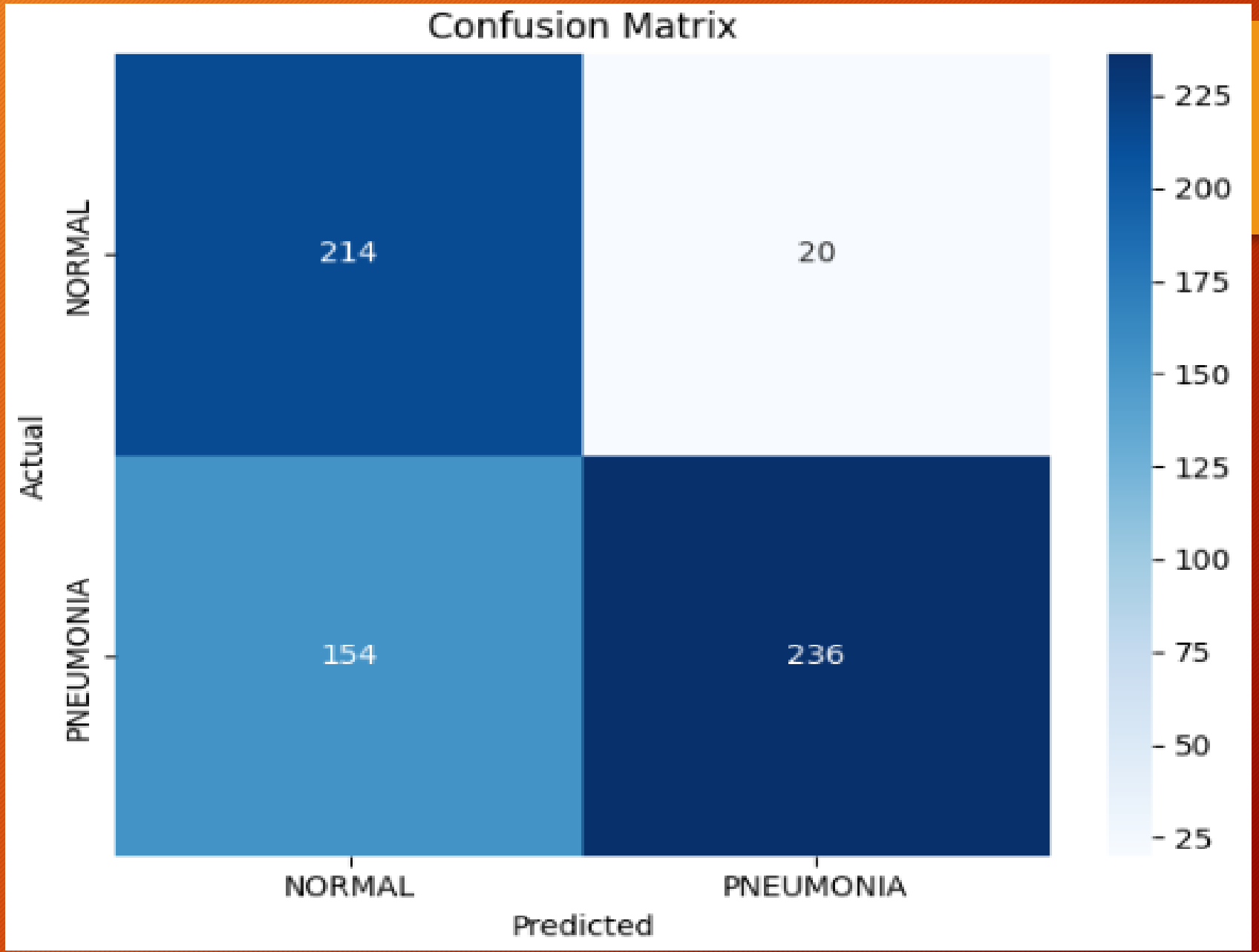
1. Data Preprocessing (resize, normalize, augment)
2. Data Splitting (train, validation, test)
3. Model Development (ResNet50 fine-tuning)
4. Model Training (hyperparameter optimization)
5. Evaluation (accuracy, precision, recall, AUC)
6. Visualization (Grad-CAM heatmaps)
7. Reporting (methodology & results)

Expected Results

- Achieve >90% classification accuracy on test data
- Provide an automated pneumonia screening tool
- Reduce radiologist workload and human error
- Improve early detection rates in clinical settings

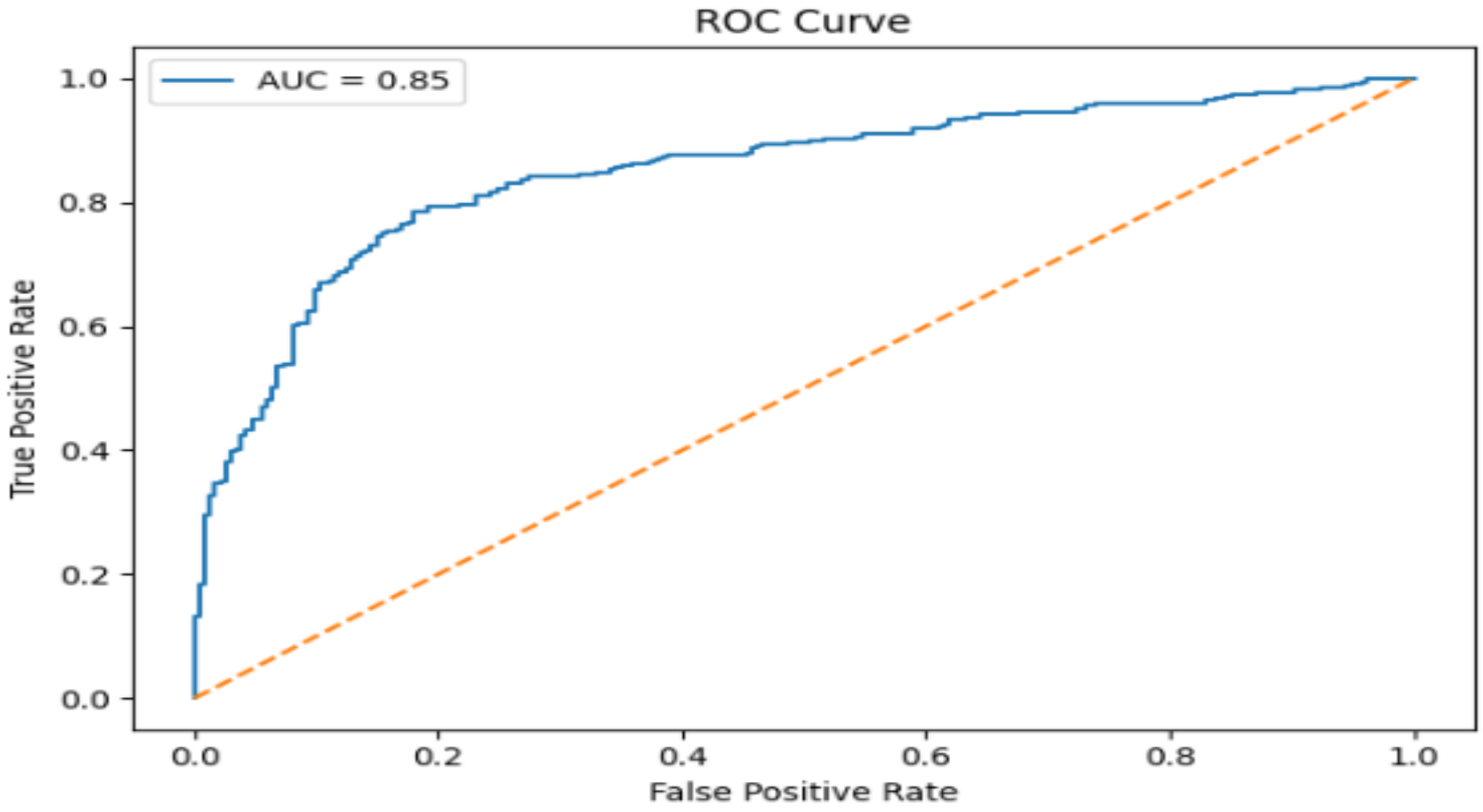

Accuracy Over Epochs
0.800
0.775
0.750
0.725
0.700
0.675
0.650
0.625
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Train Accuracy
Val Accuracy

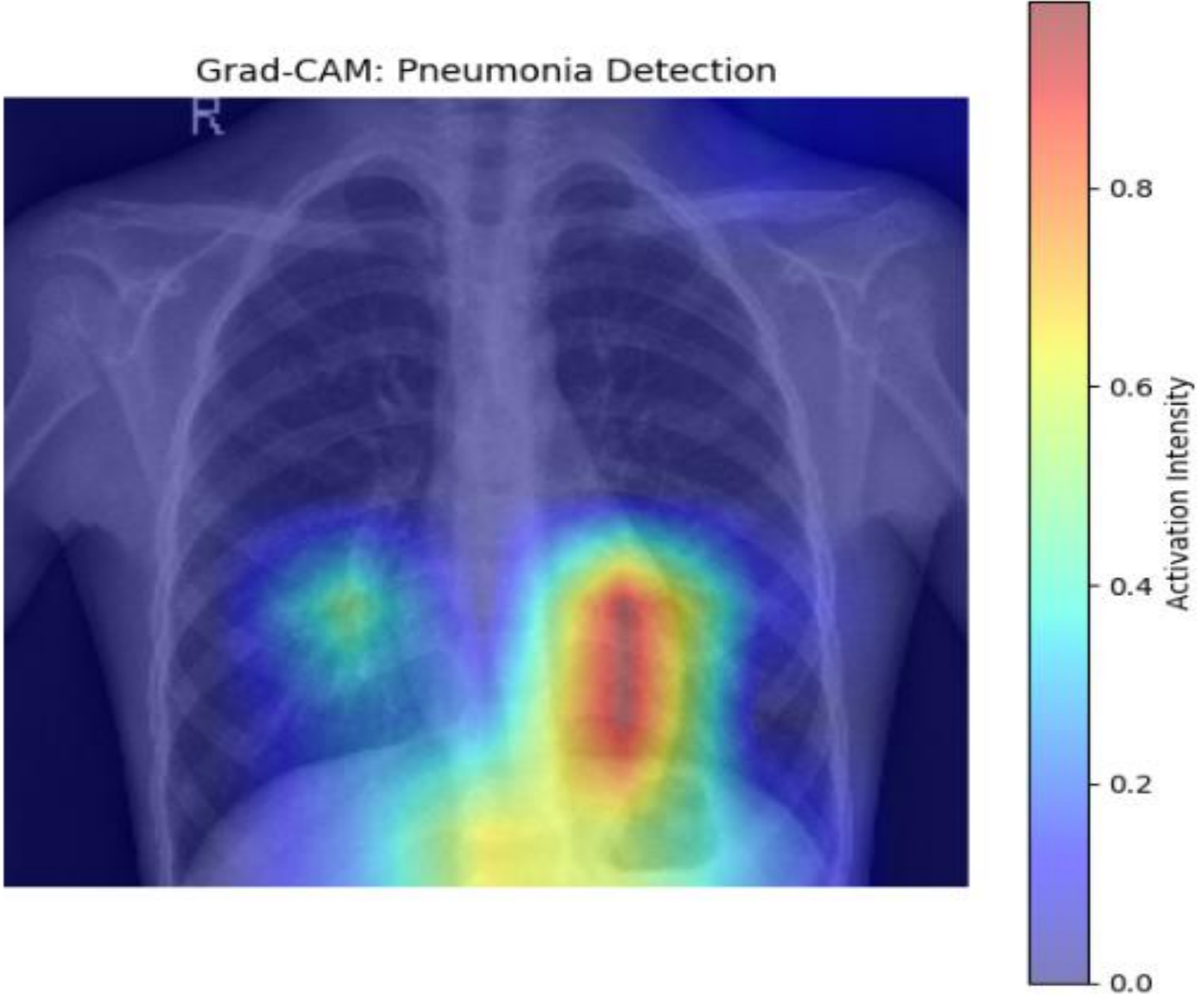

Loss Over Epochs
0.54
0.53
0.52
0.51
0.50
0.49
0.48
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Train Loss
Val Loss


Confusion Matrix
214
20
154
236
NORMAL
PNEUMONIA
Actual
NORMAL
PNEUMONIA
Predicted
225
200
175
150
125
100
75
50
25

Classification Report:

	precision	recall	f1-score	support
NORMAL	0.58	0.91	0.71	234
PNEUMONIA	0.92	0.61	0.73	390
accuracy			0.72	624
macro avg	0.75	0.76	0.72	624
weighted avg	0.79	0.72	0.72	624




Grad-CAM: Pneumonia Detection
R
0.8
0.6
0.4
0.2
0.0
Activation Intensity

High-Activation Regions