Pneumonia Detection using a Simple CNN

Objective

The primary objective of this project was to develop and evaluate a deep learning model for the binary classification of chest X-ray images. The goal was to accurately distinguish between images of healthy patients and those with pneumonia.

Methodology

1. Dataset & Preprocessing

A subset of the Kaggle Chest X-Ray Images Dataset was used for this project. The dataset was organized into train, test, and val directories, each containing NORMAL and PNEUMONIA subdirectories.

The images were preprocessed using TensorFlow's ImageDataGenerator. This involved:

- Rescaling the pixel values to a range of [0,1].
- Resizing all images to a consistent dimension of 128×128 pixels.
- The ImageDataGenerator successfully identified 5,216 images for training, 624 for testing, and 16 for validation.

2. Model Architecture

A simple Convolutional Neural Network (CNN) was built using the Keras Sequential API. The model's architecture consists of:

- **Two Convolutional Layers:** Each followed by a MaxPooling layer to reduce spatial dimensions and extract features.
- **A Flatten Layer:** To convert the 2D feature maps into a 1D vector.
- **Two Dense Layers:** The final layers for classification, with a sigmoid activation function in the output layer for binary prediction.

The model was compiled using the adam optimizer and binary_crossentropy as the loss function.

3. Training

The model was trained for 10 epochs using the preprocessed training and validation data. During training, the model's accuracy on the training set consistently improved, indicating effective learning from the data.

Results & Analysis

Final Model Performance

The trained model was evaluated on the independent test dataset to assess its generalization capabilities.

- **Test Accuracy:** 72.92%
- **Test Loss:** 2.8465

ROC Curve Analysis

The Receiver Operating Characteristic (ROC) curve was plotted to provide a comprehensive view of the model's performance across different classification thresholds. The plot shows the trade-off between the True Positive Rate and the False Positive Rate.

The Area Under the Curve (AUC) for the model was calculated to be 0.78.

Conclusion

The simple CNN model developed for this project successfully learned to differentiate between normal and pneumonia X-ray images. The final test accuracy of **72.92%** and an AUC score of **0.78** indicate that the model is performing well, with a strong ability to distinguish between the two classes. These results demonstrate a solid foundation for medical image classification.