PNEUMONIA DETECTION

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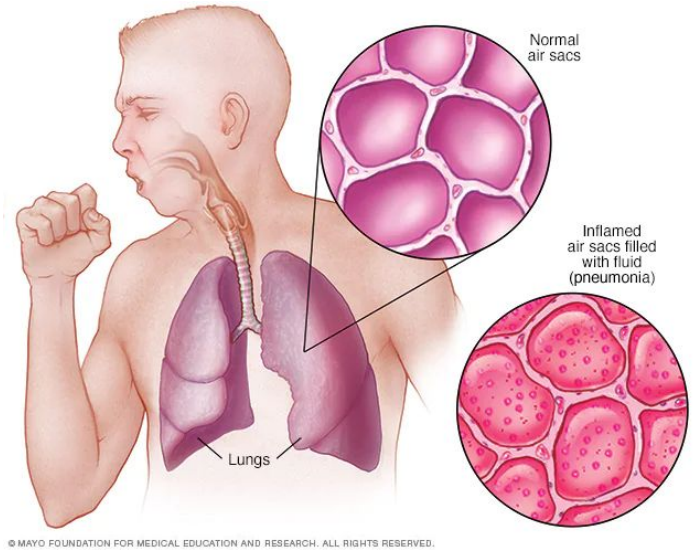
What is Pneumonia?

Pneumonia is an infection that inflames the air sacs in one or both lungs. The air sacs may fill with fluid or pus (purulent material), causing cough with phlegm or pus, fever, chills, and difficulty breathing. A variety of organisms, including bacteria, viruses and fungi, can cause pneumonia.



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How is Pneumonia detected?

Methods of diagnosing Pneumonia include CT Scan of the lungs, Ultrasound of the chest, MRI of the chest, needle biopsy of the lung or a chest x-ray.

A chest x-ray allows the doctor to see the heart, lungs and blood vessels. The radiologist particularly looks out for white spots in the lungs, which are called ‘infiltrates’ that identify the infection.

The radiologist can easily determine whether the person has pneumonia by looking, now the task is to develop a CNN that can classify the chest x-ray as either normal or affected with pneumonia.

How Pattern Recognition can help?

Deep learning models, specifically convolutional neural networks (CNNs), are used extensively for various image classification problems. However, such models perform optimally only when they are provided with a large amount of data.

For biomedical image classification problems, such a vast amount of labeled data is difficult to acquire because it requires that expert doctors classify each image, which is an expensive and time-consuming task.

Dataset

- Chest X-Ray Images for Pneumonia from Kaggle
- Contains around 5800 images, divided into training, validation and testing sets
- For training -
  - 1341 normal
  - 3875 pneumonia
- For testing -
  - 234 normal
  - 390 pneumonia
- For validation -
  - 8 normal
  - 8 pneumonia

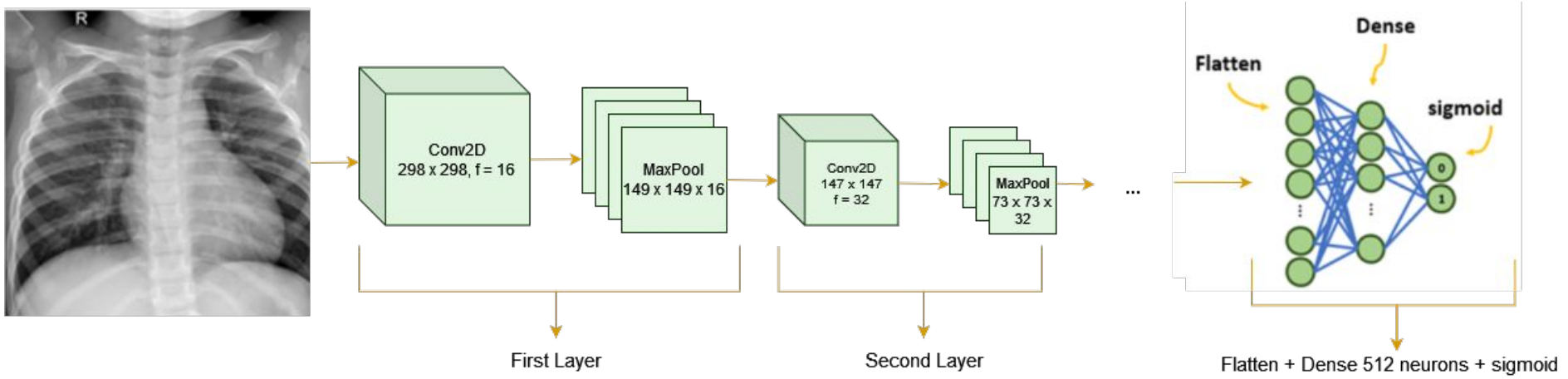
CNN Model

We have built a model a CNN model for Pneumonia detection from scratch which consists of 5 layers and follows with a fully connected neural network. Then the trained model is evaluated using separate unseen data to avoid bias prediction.

Before the model is fitted for training, the following parameters need to be configured as

- loss: binary_crossentropy is the most suitable loss function
- optimizer: RMSprop with a learning rate of 0.001 will be used
- metrics: accuracy is the measurement metric to obtain the prediction accuracy rate on every epoch

CNN Model


R
Conv2D
298 x 298, f = 16
MaxPool
149 x 149 x 16
Conv2D
147 x 147
f = 32
MaxPool
73 x 73 x
32
...
Flatten
Dense
sigmoid
0
1
First Layer
Second Layer
Flatten + Dense 512 neurons + sigmoid

CNN Model

- Images are not fully black and white yet, so input shape is 300x300x3 (will be converted to grayscale later)
- 5 layers of Convolution layer followed by Pooling layer
- Output size goes from 16 to 256 neurons for the convolution layers
- Flattening layer
- One fully connected (dense) layer of 512 output size, followed by the last output layer which is a dense layer with output size 1
- Relu activation function used for all layers except last, last uses sigmoid because we want 1 or 0 classification

Results

- The accuracy of the test dataset reached 78% which indicates a decent model.
- The recall value of the pneumonia class is observed to be around 0.63.
- Recall is often favoured in medical imaging cases over other performance evaluating parameters, as it gives a measure of false negatives in the results.
- The focus would be only models with great recall values, decent accuracies and F1 scores.

Conclusion

- The predictive model can be improved even better by performing data augmentation or implementing a transfer learning concept which facilitates the model a room for improvement.
- Transfer learning, despite having the most successful models with pre-trained weights, could not be implemented here as the size of dataset taken for our research is not as extensive compared to ones which generally employ transfer learning. Therefore, after obtaining a more suitable dataset transfer learning can be applied onto this model.

Thank You