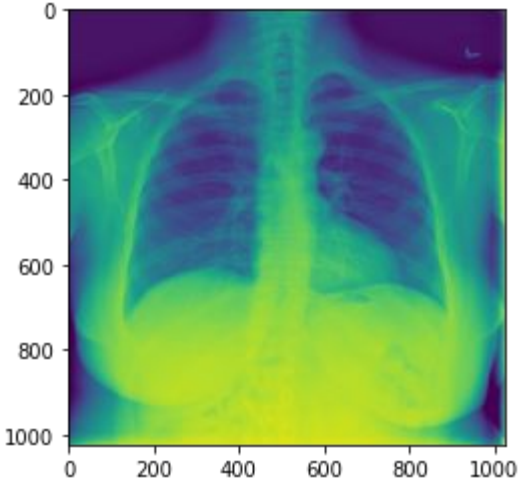
Pneumonia Classification from Chest X-Ray images

Giri Madhav 671915100
Shiva Praveen 676463688

Data Description

Dataset has 2425 chest X-Ray images of size 1024 x 1024 pixels with labels pneumonia and normal. Task is to classify test images whether person has pneumonia or not. Input is the image and output is 0 or 1 representing normal and pneumonia respectively.



Workflow

1. Data Preprocessing
    - Read images
    - Resize images
    - Augmentation
2. Data modelling
3. Performance Evolution

Data preprocessing

Each image is converted to the size of 224 x 224 pixels. Dataset size is increased by applying Data augmentation techniques like Rotating images, converting image to grayscale, Horizontal flip, Vertical flip, Blurring etc..

Dataset is split to train data and validation /test data to calculate the performance metrics of the model, which is trained using train data, on test data.

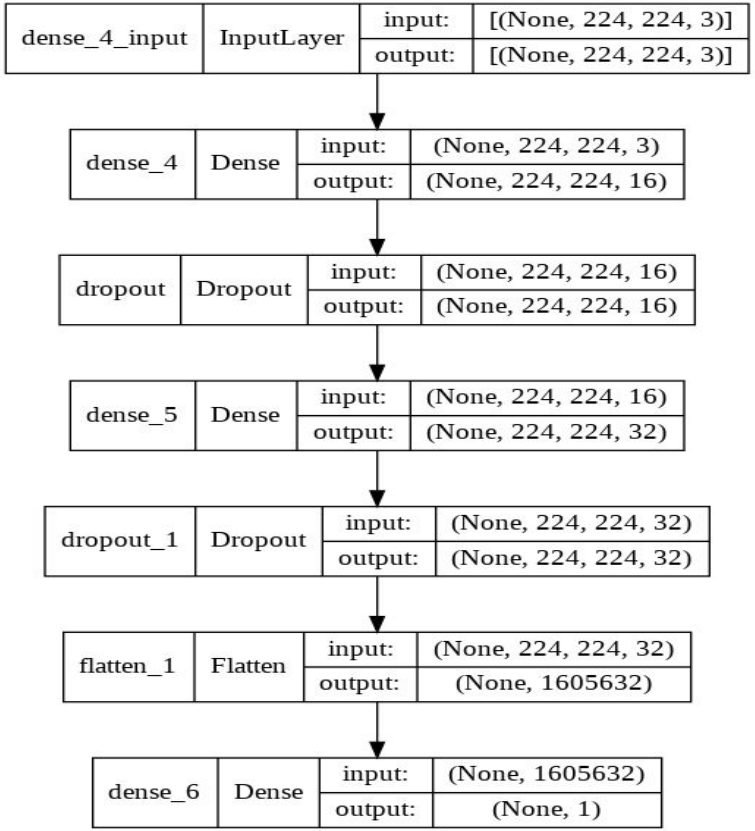
Both train and test data are converted as a generator object, which is passed to the model while fitting it.

Data Modelling

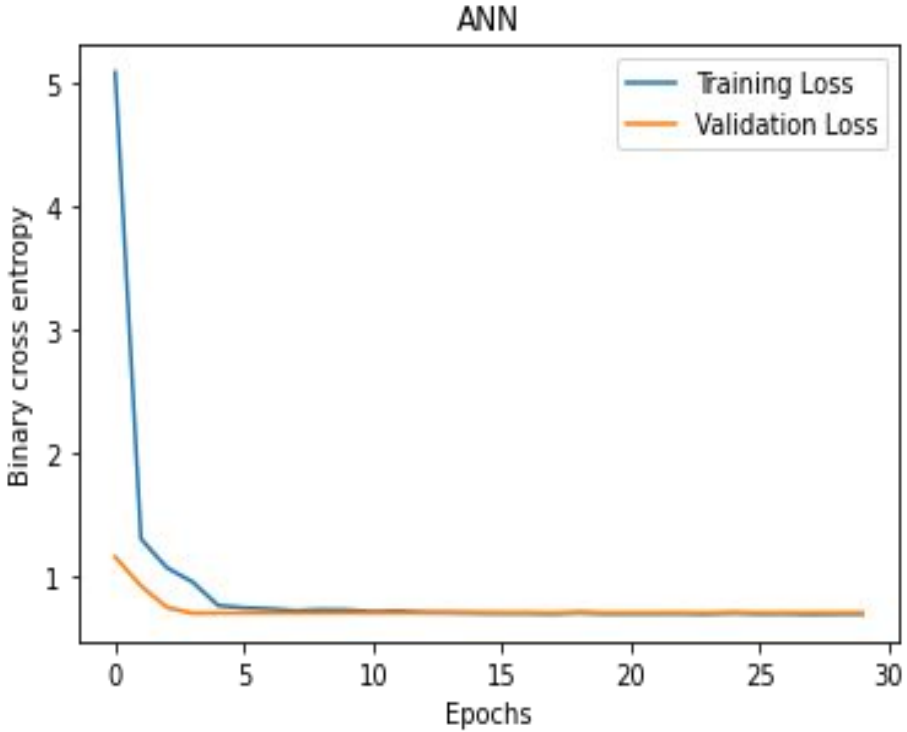
Models used are:

1. Artificial Neural Network
2. Convolutional Neural Network with dropout
3. Convolutional Neural Network with dropout and batch-normalization
4. Convolutional filters and Random Forest
5. Imagenet architecture

Artificial Neural Network



Loss


ANN
Training Loss
Validation Loss
Binary cross entropy
Epochs
5
4
3
2
1
0
5
10
15
20
25
30

Hyper parameters to this ANN architecture :

Number of layers : 3

Learning rate : 0.001

Optimizer : Adam

Epochs : 30

- Regularisation technique Dropout method is used to avoid overfitting of the model.
- Callbacks are used to checkpoint and save the best model and also to stop early if no improvement in validation loss.

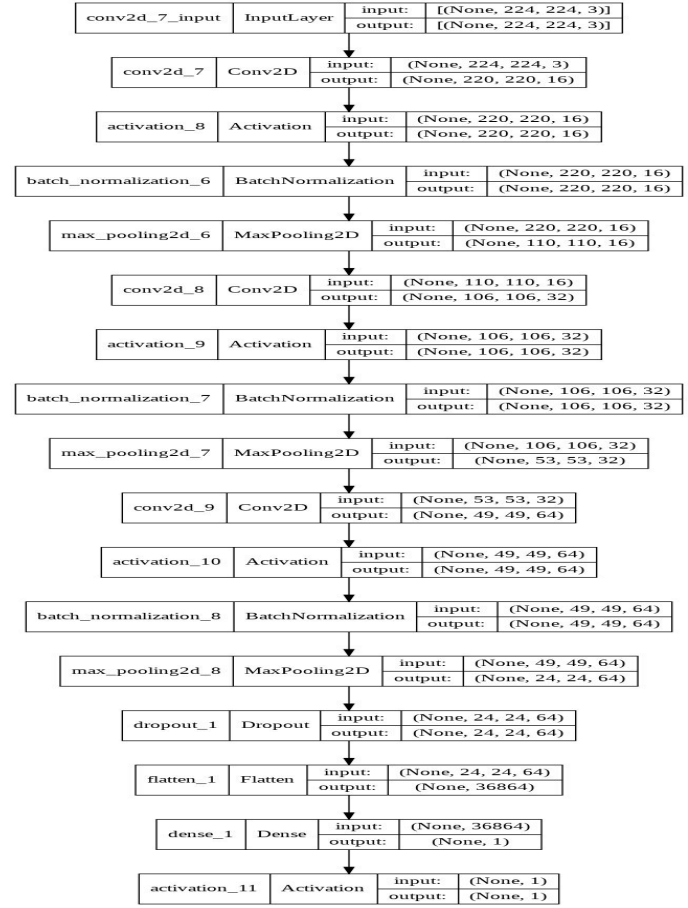
Train accuracy : 55

Test accuracy : 47

Training Time : 3 mins

Inference Time : 12 secs

Convolutional Neural Network with Dropout

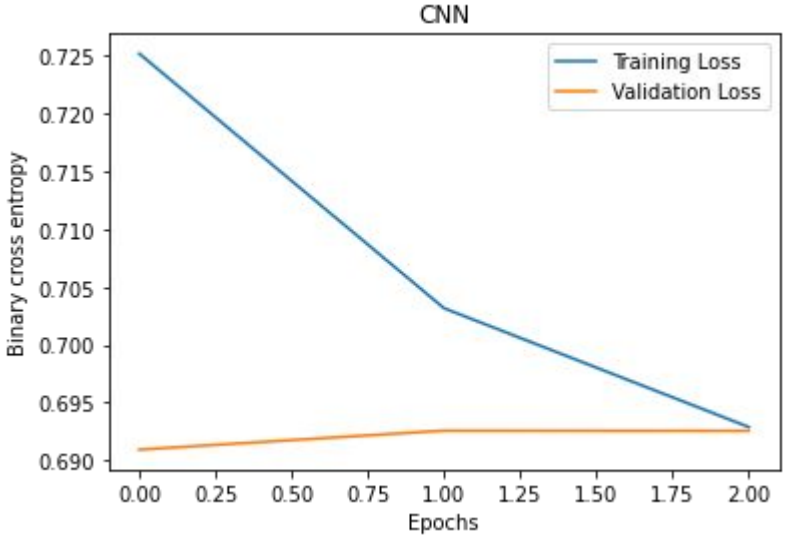


LOSS

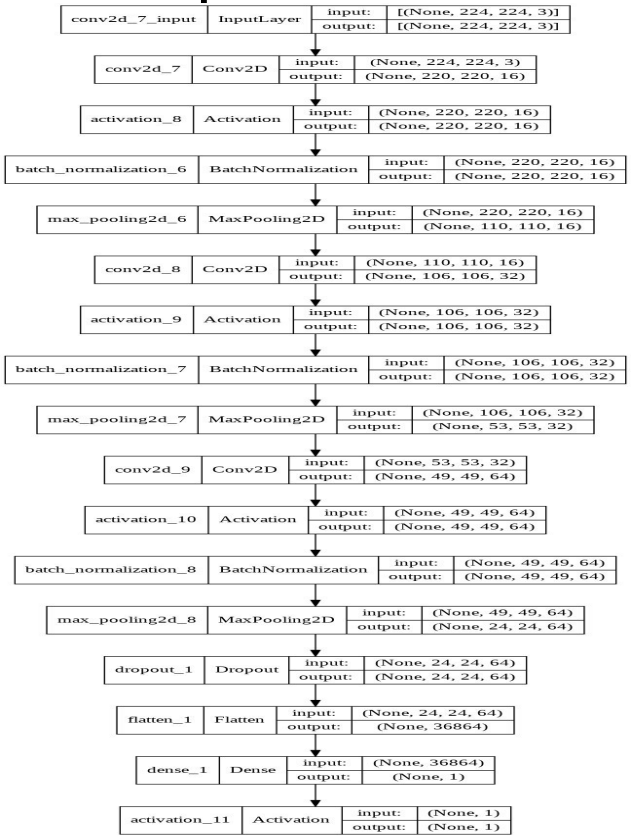
Train Accuracy : 70 Precision : 50 Recall : 25

Test Accuracy : 53 Precision : 66 Recall : 20

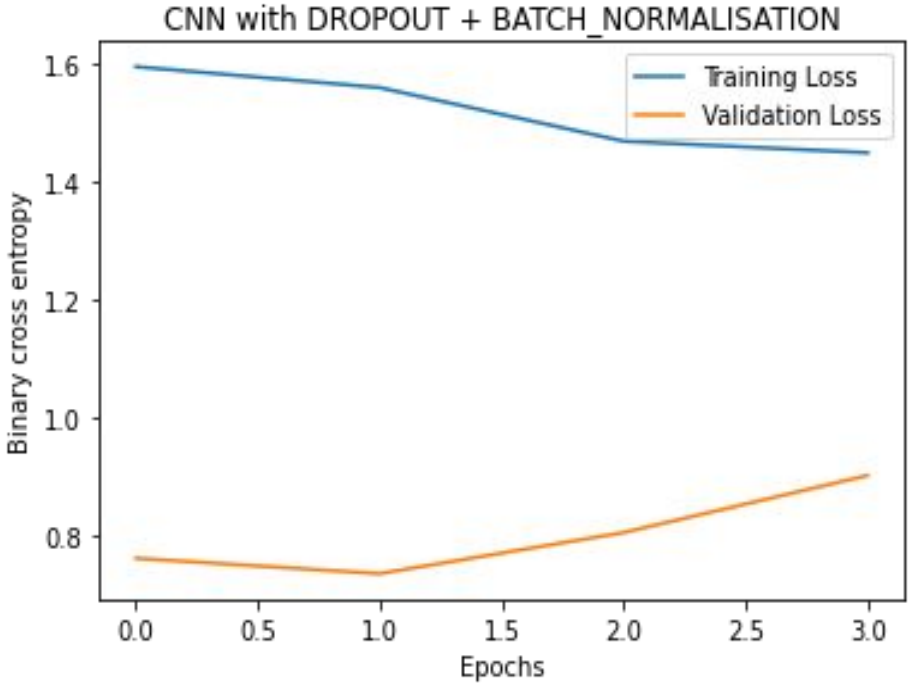
Training speed : 3 mins Inference speed : 11 secs



Convolutional with Dropout and Batch Normalisation



Loss


CNN with DROPOUT + BATCH_NORMALISATION
Training Loss
Validation Loss
Binary cross entropy
1.6
1.4
1.2
1.0
0.8
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Epochs

- For learning : 0.0001

  Train -- accuracy : 51 precision : 48 Recall : 50

  Test -- accuracy : 55 precision: 50 Recall:70

  Training Speed : 5 mins Inference Speed : 12 secs

- For learning : 0.0005

  Train -- accuracy : 52 precision : 49 Recall : 49

  Test -- accuracy : 49 precision: 49 Recall: 47

  Training Speed : 5 mins Inference Speed : 12 secs

Learning rate 0.0001 gave better performance metrics with RMSprop optimizer binary cross entropy loss.

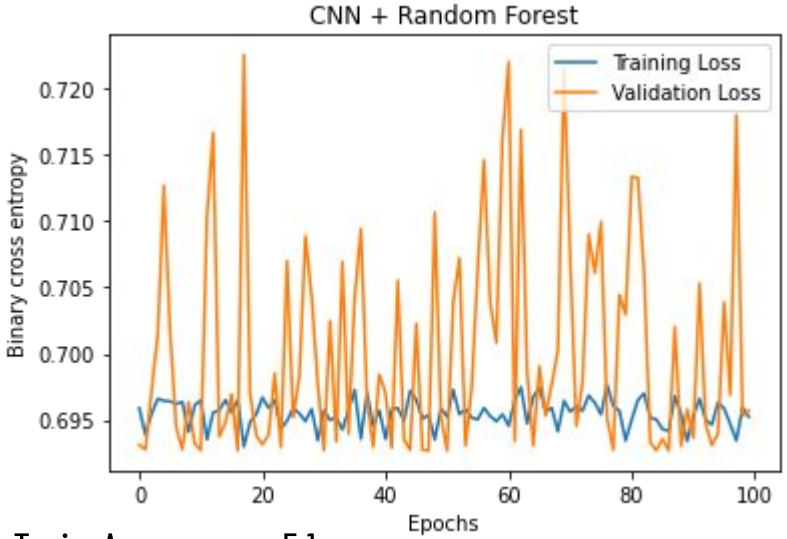
Convolutional filters and Random Forest

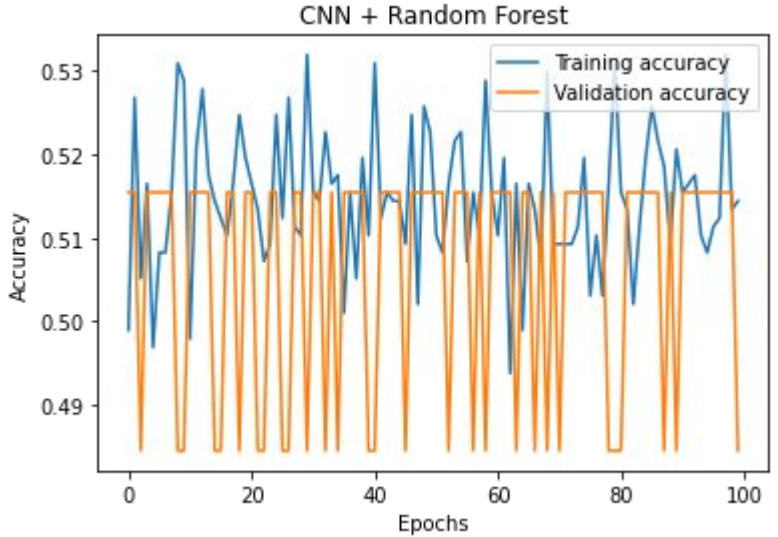
Convolutional filters are used to extract features from the images that can be passed as input to the Random forest machine learning algorithm.

When the data is small, Machine learning models perform better than the deep learning models.

Simple network of convolutions can be considered to extract features.

Loss and Accuracy





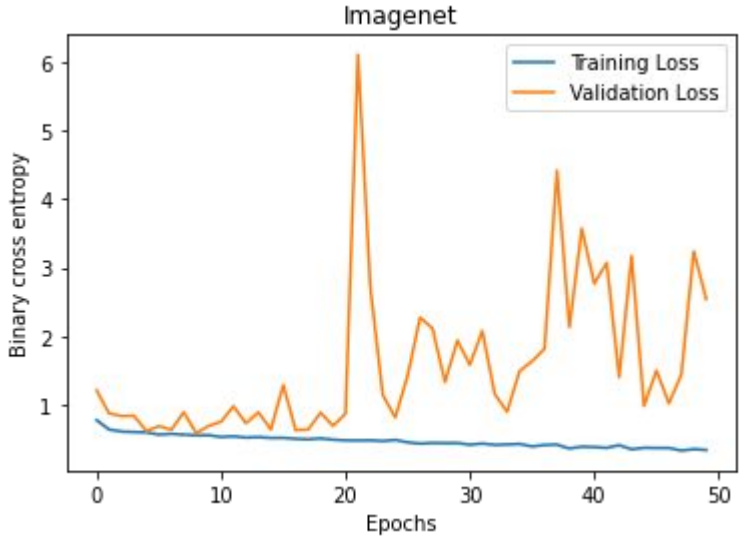
Train Accuracy : 51

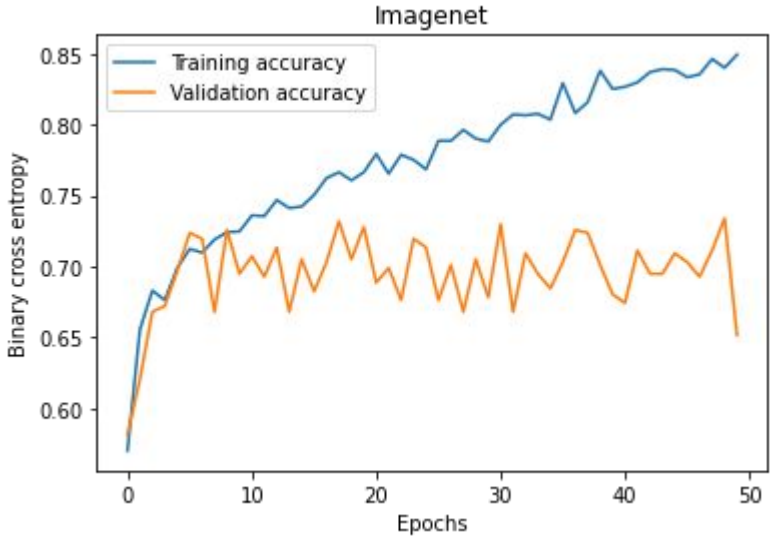
Test Accuracy : 49

Training Time : 26 mins

Inference Time : 12 secs

Image Net





Train accuracy : 85 Precision : 84 Recall : 84.5

Test accuracy : 73 Precision : 63 Recall : 62

Training Speed : 64 mins Inference Speed : 14 secs

Comparison Table

Model	ANN	CNN	CNN with Batch Normalisation and Dropout	Convolutional filter and Random Forest	ImageNet
Accuracy	47	53	55	49	73