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Activity 18: Convolutional Neural Network

Mary Chris Go / 2014 11122

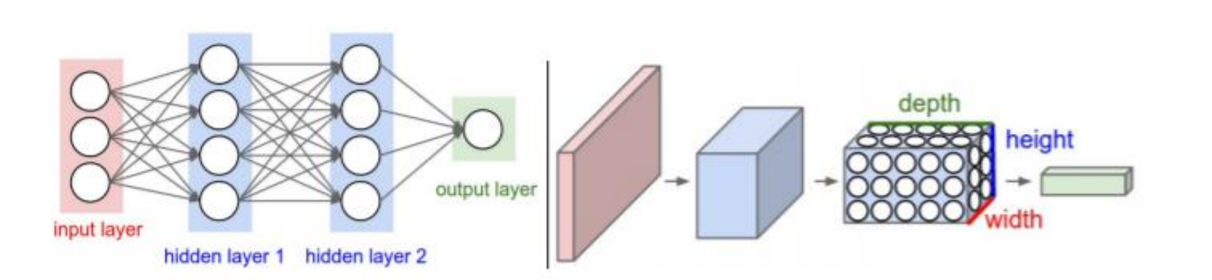
Goal

To be able to classify chest radiographs using convolutional neural network.

PS. I asked permission from Ma'am Jing to use a different dataset and she allowed me. ☺

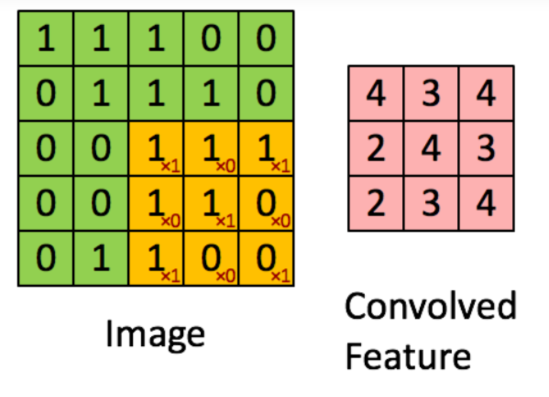
Neural Network

We see here a regular neural network model. Each layer tries to extract features from the images.



How it Works

The input feature or the set of signals goes inside the input layer which consists of input neurons. These signals are then forward to the hidden layer. The hidden layer does something to these signals and the output will be passed on to the output layer. We train the network by just adjusting the weights according to the bias we set. This change rule will depend from the optimization of some cost function.



Convolving

Green – input channel
Yellow – convolutional filter
Pink – output channel

Dataset

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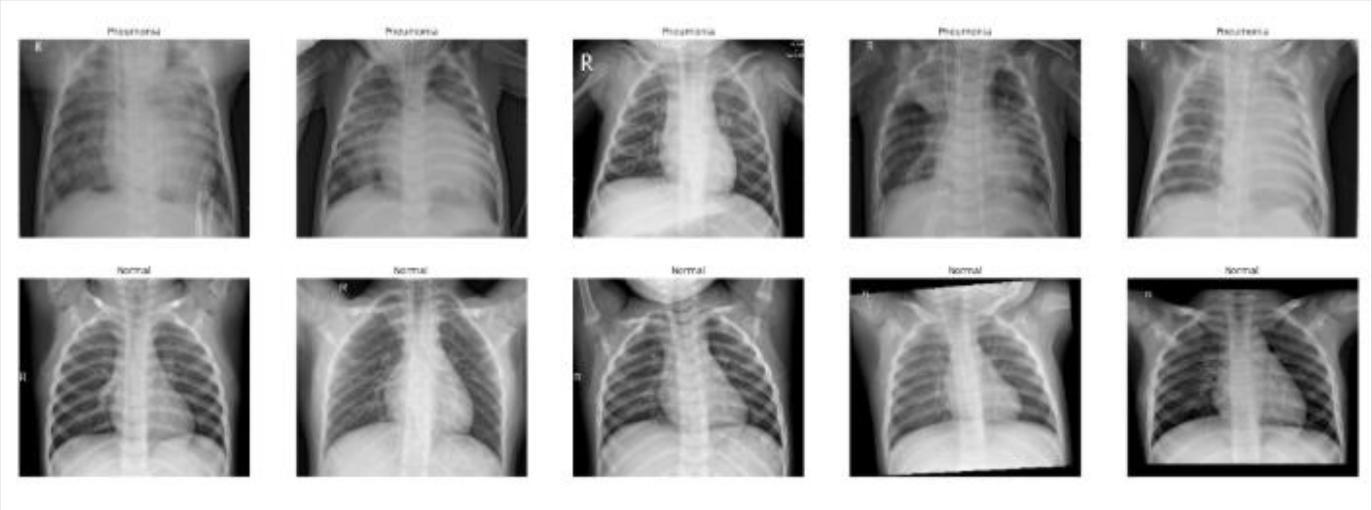


The images were taken from Kaggle Pneumonia challenge. These images were anonymized chest radiographs from pediatric patients. Images on top row were labeled as pneumonia positive while those in the bottom row are labeled as pneumonia negative. There are 5863 chest x-ray images. 3883 of these images were labeled as positive while the rest are negative. From the dataset, we can already see that there can be a bias since there is an imbalance number per class.

Implementation of the Algorithm

```
model = Sequential()
#conv2d((Integer, the dimensionality of the output space), stride, relu)
model.add(Conv2D(32,(7,7),activation='relu')) #layer creates a convolution ke
model.add(MaxPooling2D((2,2))) #integer or tuple of 2 integers, factors by wh
model.add(BatchNormalization()) #nomalizing all data set
model.add(Dropout(0.15)) #prevents overfitting 0.15: Fraction of the input un

model.add(Conv2D(64,(5,5),activation='relu'))
model.add(MaxPooling2D((2,2)))
model.add(BatchNormalization())
model.add(Dropout(0.15))

model.add(Conv2D(128,(3,3),activation='relu'))
model.add(MaxPooling2D((2,2)))
model.add(BatchNormalization())
model.add(Dropout(0.15))

model.add(Conv2D(128,(3,3),activation='relu'))
model.add(MaxPooling2D((2,2)))
model.add(BatchNormalization())
model.add(Dropout(0.15))

model.add(GlobalAveragePooling2D())
model.add(Dense(1000, activation='relu')) #Dense(dimensionality of the output
model.add(Dense(2,activation='softmax')) # it returns the probabilities of ea
model.compile(optimizer='adam', loss = 'categorical_crossentropy', metrics=['
#model.summary()
```

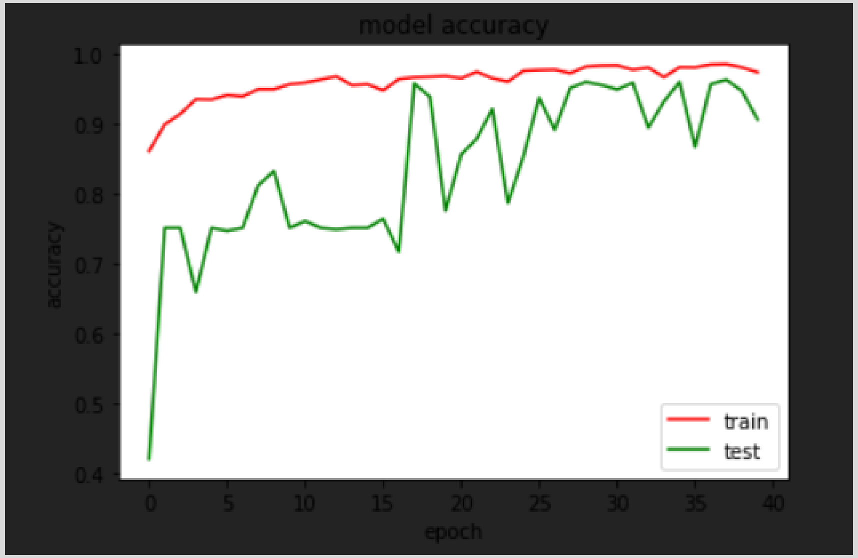
The experiment was performed on Windows 10, Intel Core i7, and an NVIDIA GeForce 1050ti.

Labeled dataset were in 224 x 224 pixels in size. The CNN model has 22 layers composed of one input, one output, and 20 hidden layers. The first four hidden layers were extracting features, down-sampling the input image and reducing its dimensionality. It works also in normalizing the dataset.

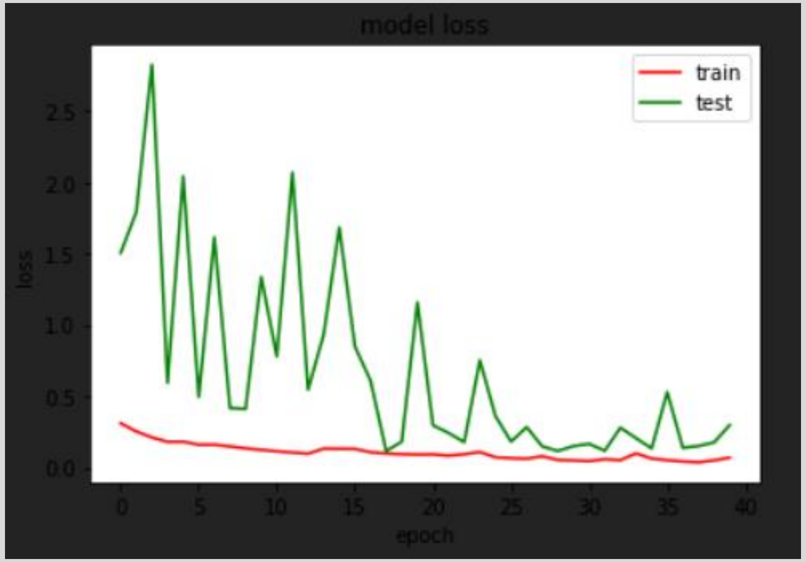
I was able to make my model possessed 26, 688, 886.

Neural network are optimized by a stochastic gradient descent algorithm with a batch size of 32 for 100 epochs. I divided and randomly select 624 images in the dataset.

Model Accuracy and Model Loss



Model Accuracy



Model Loss

See graphs clearly. I can’t change it to white background, but labels were indicated for the x and y axis.

Metric of Algorithm

$$\text{Precision} = \frac{\#\text{ of True Positives}}{\#\text{ of Predicted Positives}}$$

Predicted Label \ True Label	Pneumonia	Normal
Pneumonia	275	28
Normal	206	115

(a)

To test the neural network established, a confusion matrix was used.

Through this, we have checked that the model made was 75% accurate with a running time of 148 minutes.

The theoretical efficiencies can be further improved with a good dataset that can show more ground truth training data to improve the adaptability of these CNN.

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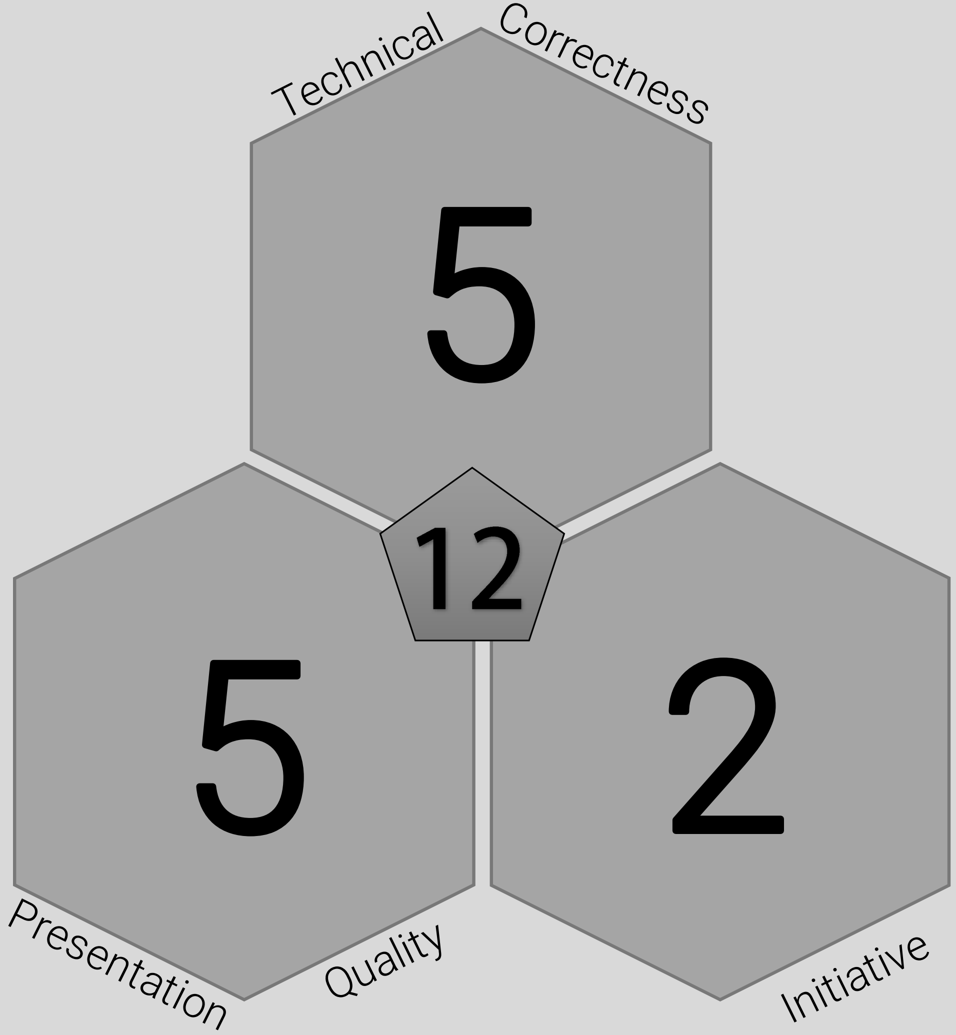
Summary

Understanding the very basics of CNN was the most useful thing to do before molding my own neural model. This project was the most fun activity. I really like how we applied everything we have done into a single model that could detect a binary option. I appreciate artificial intelligence more and its many advantages especially in the medical field.

It was doable for me as my thesis worked on something similar. I used a dataset that was familiar to me already. The difference is I had a better understanding because of the step-by-step process given.

Self-Evaluation



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References

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