Diabetic Retinopathy Detection Using Deep Learning

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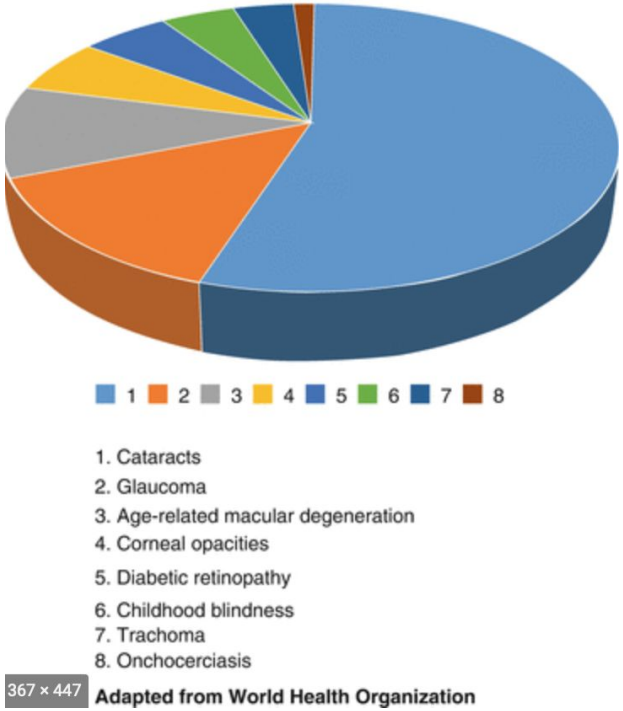
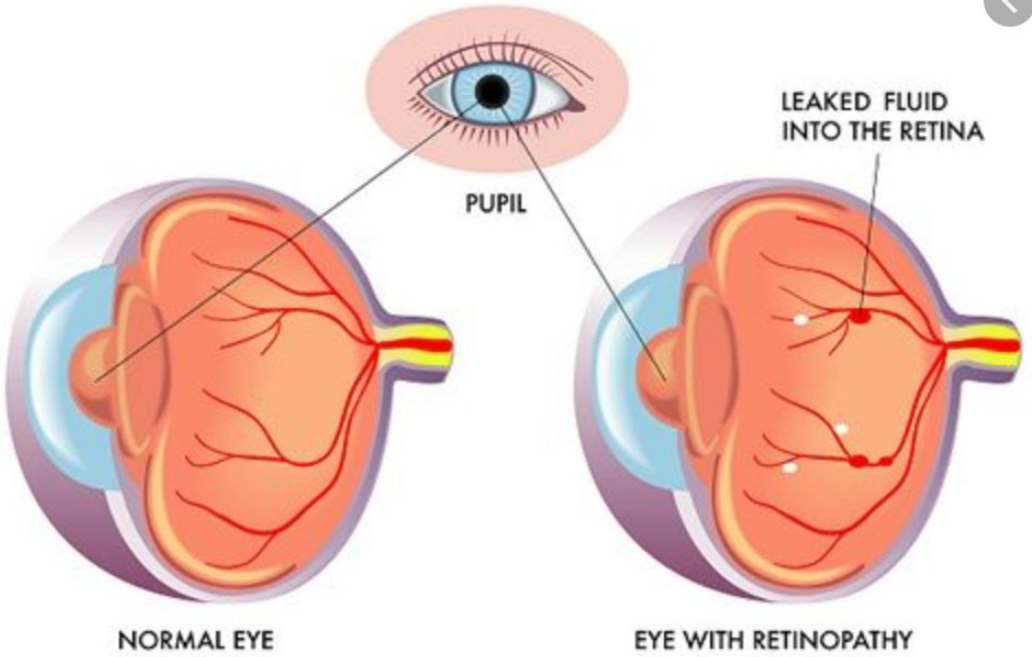
Problem Statement (BackGround)

Diabetic retinopathy is a diabetes complication that affects eyes. Damage to the blood vessels of the light-sensitive tissue of the retina causes this complication. Diabetic retinopathy (DR) is a leading cause of vision-loss globally. Approximately one-third of 285 million people with diabetes mellitus worldwide have signs of DR.

Imagine being able to detect DR before it causes problems. Early detection of DR could save millions of diabetics from losing their vision, which is the goal of a problem featured in Kaggle by [Asia Pacific Tele-Ophthalmology Society (APTOS).]



What is Diabetic Retinopathy?



Approach

Build a deep learning model to classify the images for the diagnosis code of the severity. And the model can be accessed for DR prediction of the retinal photography image. (which wont require the clinician to diagnose the severity.)

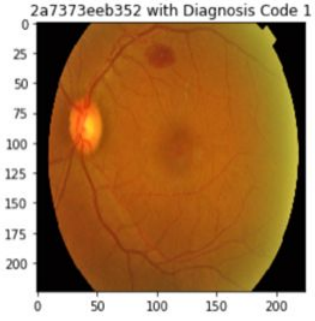
Training DataSet

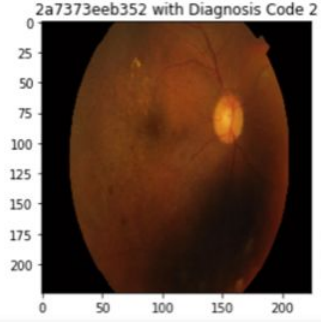
Data set of retina images taken using fundus photography under a variety of imaging conditions.

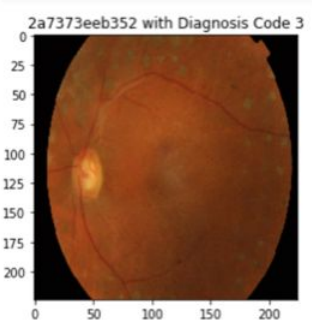
And classification of the image for the severity of diabetic retinopathy on a scale of 0 to 4

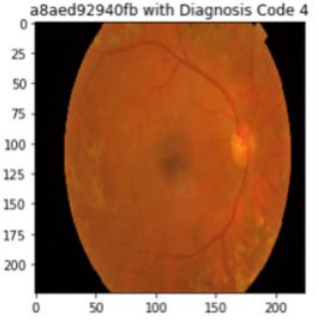
Training Image Count	3662 Images
Size	8GB
Classification of images	Provided in the train.csv

Exploratory Data Analysis









Dignosis Code 0 : No Diabetic Retinopathy
Diagnosis Code 1 : Mild nonproliferative retinopathy — microaneurysms
Diagnosis Code 2: Moderate nonproliferative retinopathy — blocked blood vessels
Diagnosis Code 3: Severe nonproliferative retinopathy — more blocked blood vessels
Diagnosis Code 4: Proliferative retinopathy — blood vessels grow on the retina

Exploratory Data Analysis

Daignosis Code	No of Images
0	1805
2	999
1	370
3	193
4	295

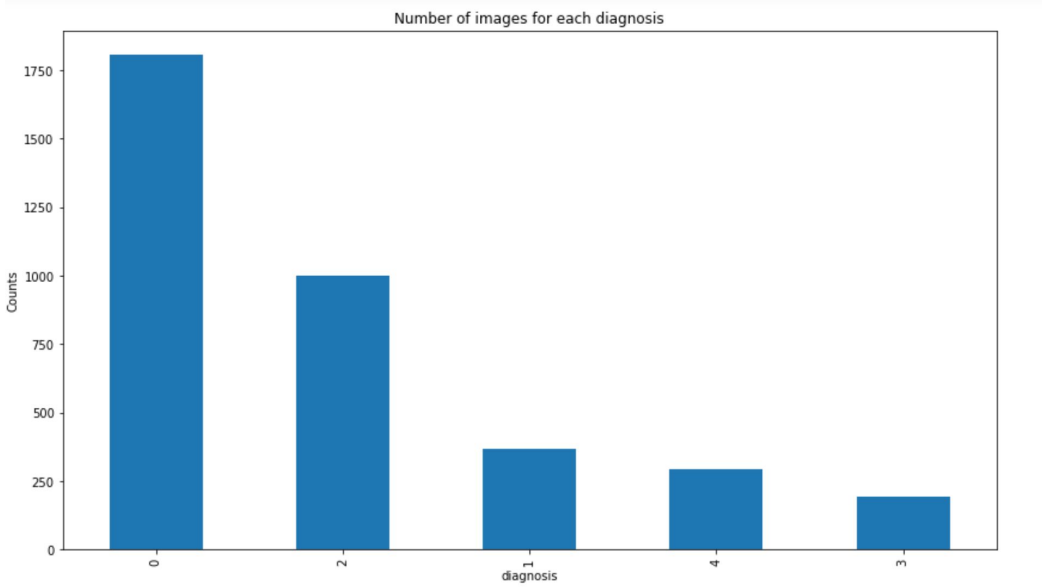
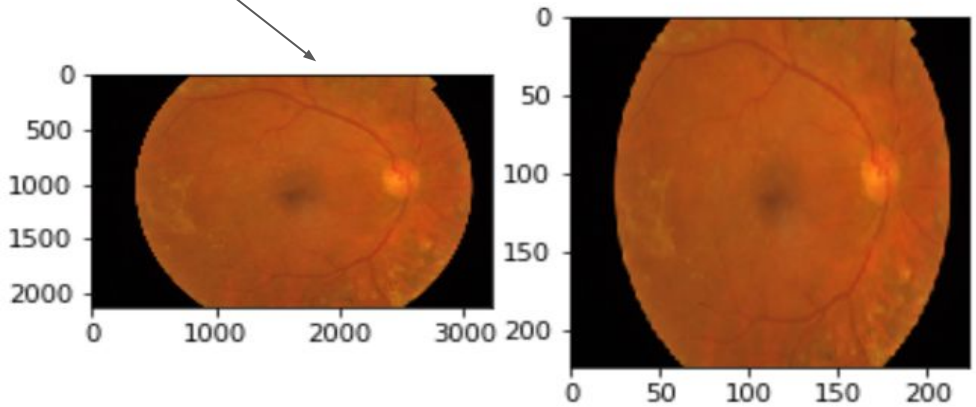


Image Preprocessing

Original Image
with (3126,2136,3)

Resized Image
with (224,224,3)

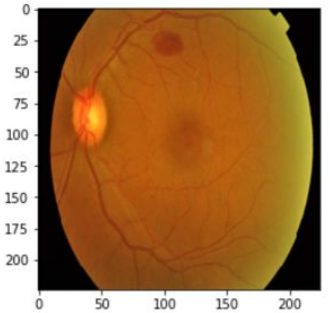


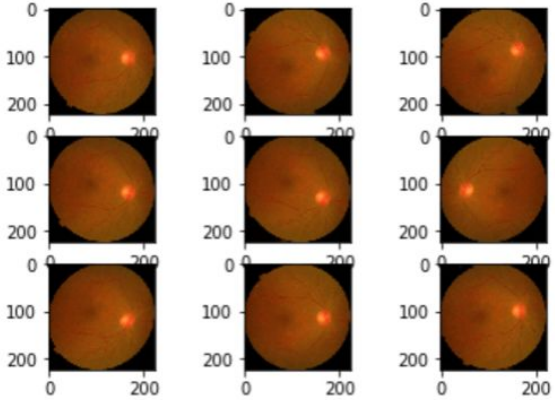
The training images are with different sizes, all the images are resized to (224,224,3) while reading the image

Image Augmentation

Deep networks need large amount of training data to achieve good performance. To build a powerful image classifier using very little training data, image augmentation is usually required to boost the performance of deep networks. **Image augmentation** artificially creates training images through different ways of processing or combination of multiple processing, such as random rotation, shifts, shear and flips, etc.

Original Image

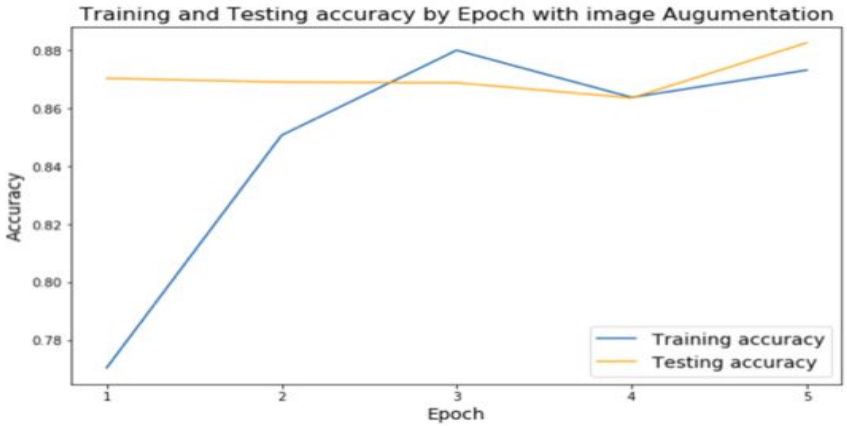


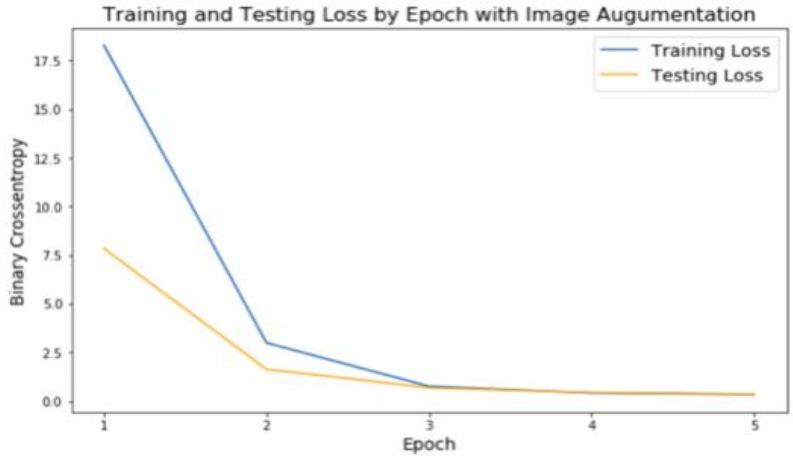


Artificially Created Images based on original Image using keras Image Data Generator

Deep Learning - Model1 - CNN Layer

Deep Learning model with two convolutional layer, The validation accuracy has improved after the image augmentation to 0.85





Deep Learning - Transfer Learning

Deep convolutional neural network models may take days or even weeks to train on very large datasets.

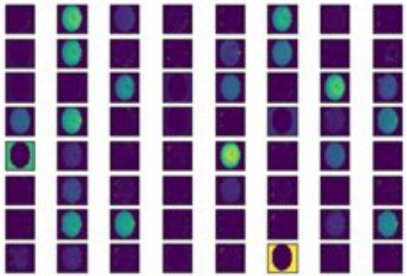
A way to short-cut this process is to re-use the model weights from pre-trained models that were developed for standard computer vision benchmark datasets, such as the ImageNet image recognition tasks. Top performing models can be downloaded and used directly, or integrated into a new model for your own computer vision problems.

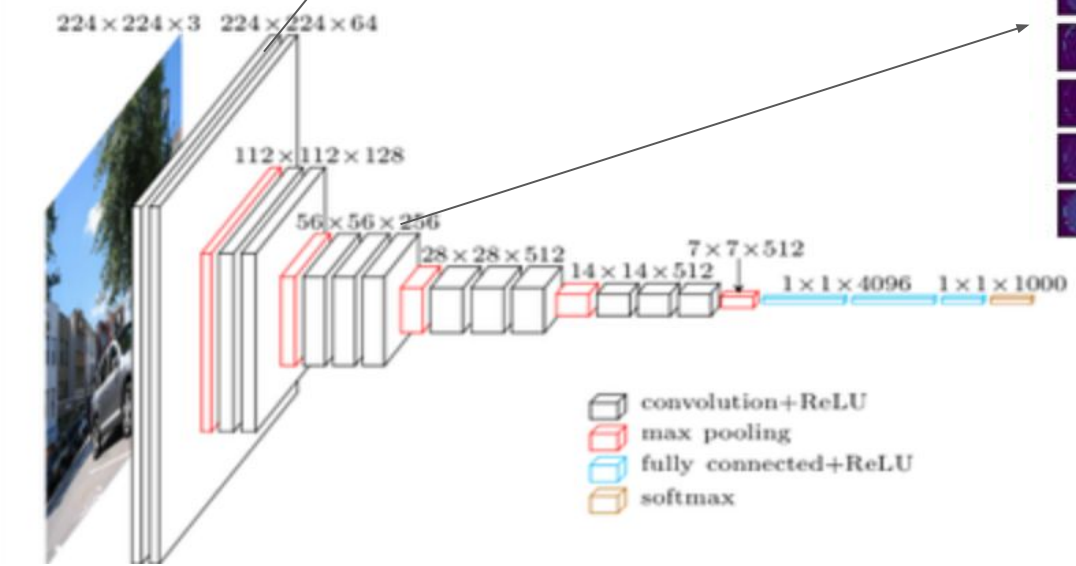
Tried with pre-trained models VGG16, Resnet101,Densenet121.
VGG16 pretrained model gives better accuracy

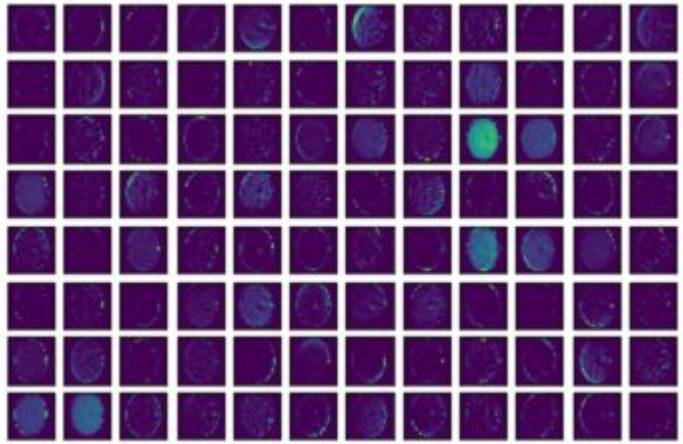
VGG16 ---------- 0.91
Resnet101 ---------- 0.76
Densenet121 ---------- 0.74

VGG16 - Image Transformation in between Layers

Layer1 : Transformation of the image



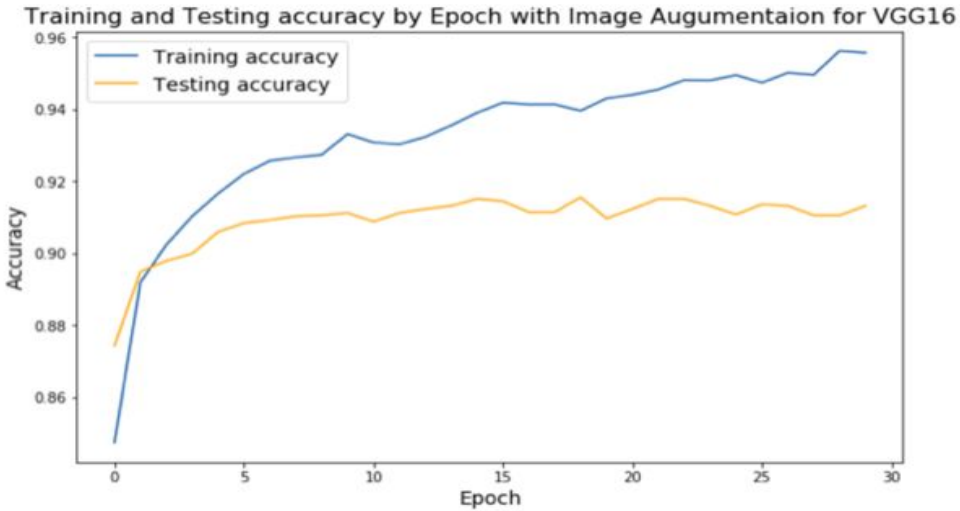


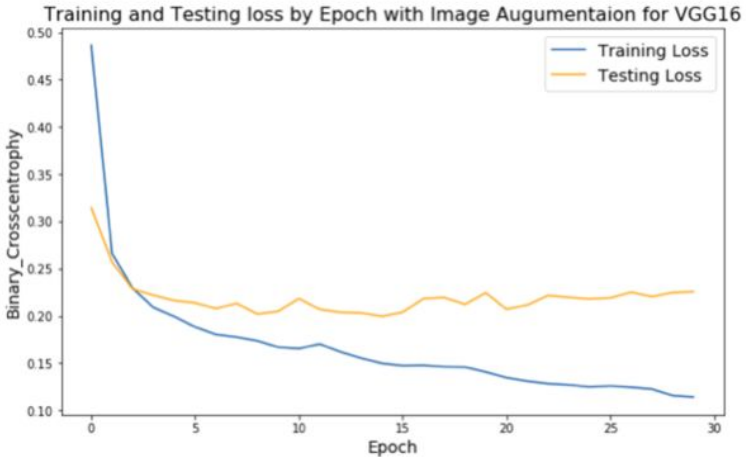


Layer5 : Transformation of the image

Model2 : VGG16 - Accuracy/Loss

Deep Learning model with VGG16 (Transfer Learning) & Image Augmentation, The validation accuracy 0.91 and loss 0.25





Conclusion

The deployed deep Learning Model to diagnose the stages of Diabetic Retinopathy wont require clinician to diagnose the stage. Model can be used for initial Screening

Rooms for Improvement:

Can be trained with more no of images(Current Model trained on 3662 Images)
Can improve the accuracy with preprocessing of the images with GuassianBlur