Diabetic Retinopathy Detection

Identify signs of diabetic retinopathy in eye images

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Introduction

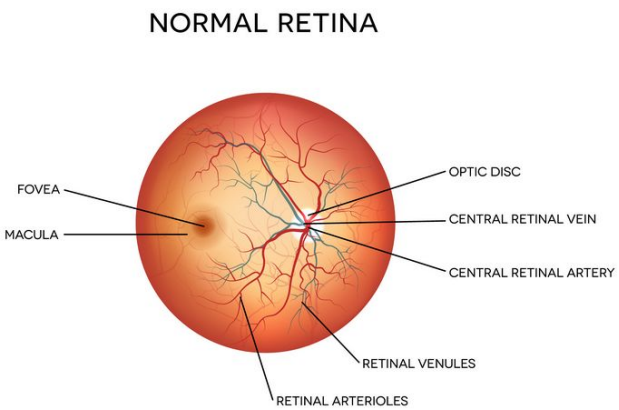
- Diabetic retinopathy is the leading cause of blindness in the working-age population of the developed world. It is estimated to affect over 93 million people.
- Currently, detecting DR is a time-consuming and manual process that requires a trained clinician to examine and evaluate digital color fundus photographs of the retina.
- The need for a comprehensive and automated method of DR screening has long been recognized, and previous efforts have made good progress using image classification, pattern recognition, and machine learning.

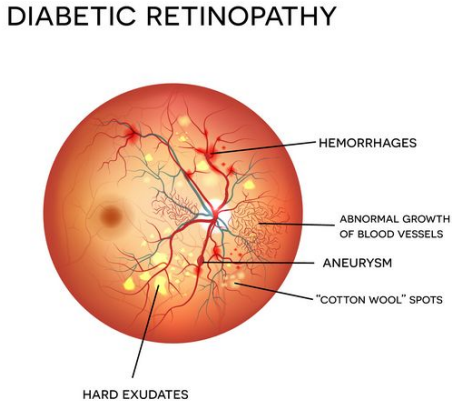
Task

Classification:
Images have five possible ratings

0: no DR
1: mild
2: moderate
3: severe
4: proliferative DR

Dataset: Color Fundus photography

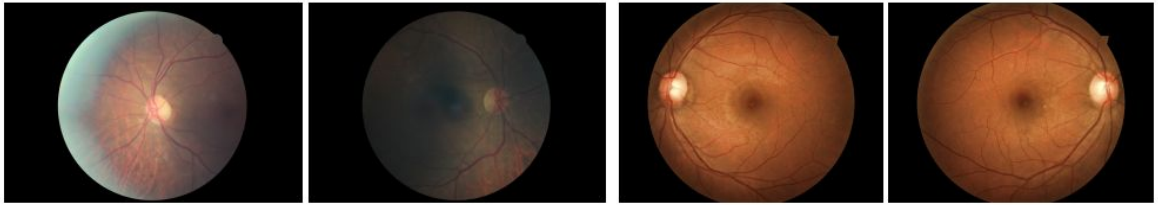




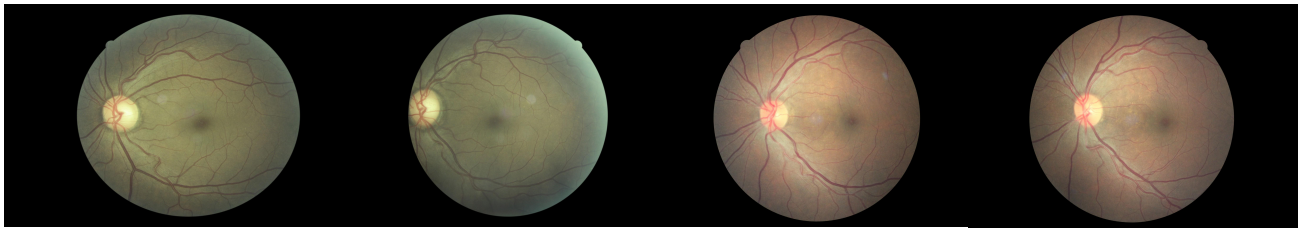
Sample Image

Data Preprocessing

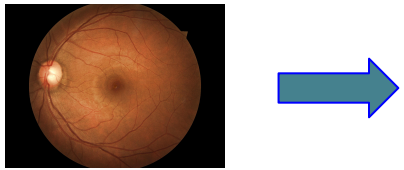
- Original Dataset



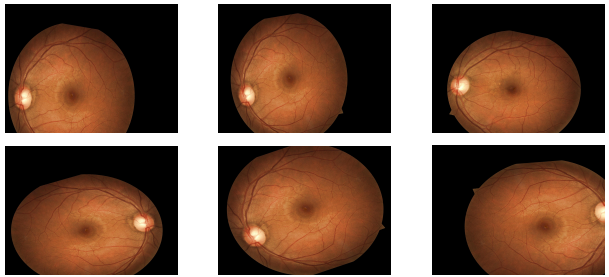
- Flipped Dataset



- Data Augmentation Example



Original Image



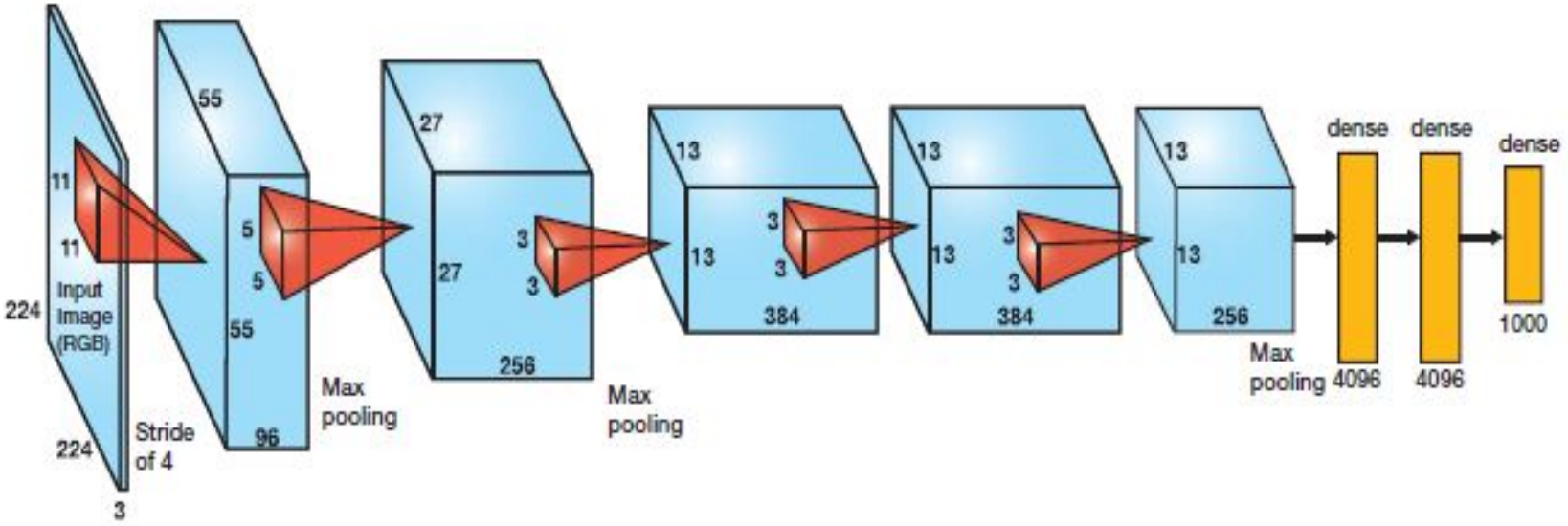
Approaches:

- Convolutional Neural Networks are known for their good performance on image classification tasks.
- We have used the latest Deep Convolutional Network models coupled with Transfer Learning to solve this problem.
- Comparative studies are done on the performance of models
- Models used
  - AlexNet
  - VGG Net
  - Inception V3
  - MobileNet

AlexNet

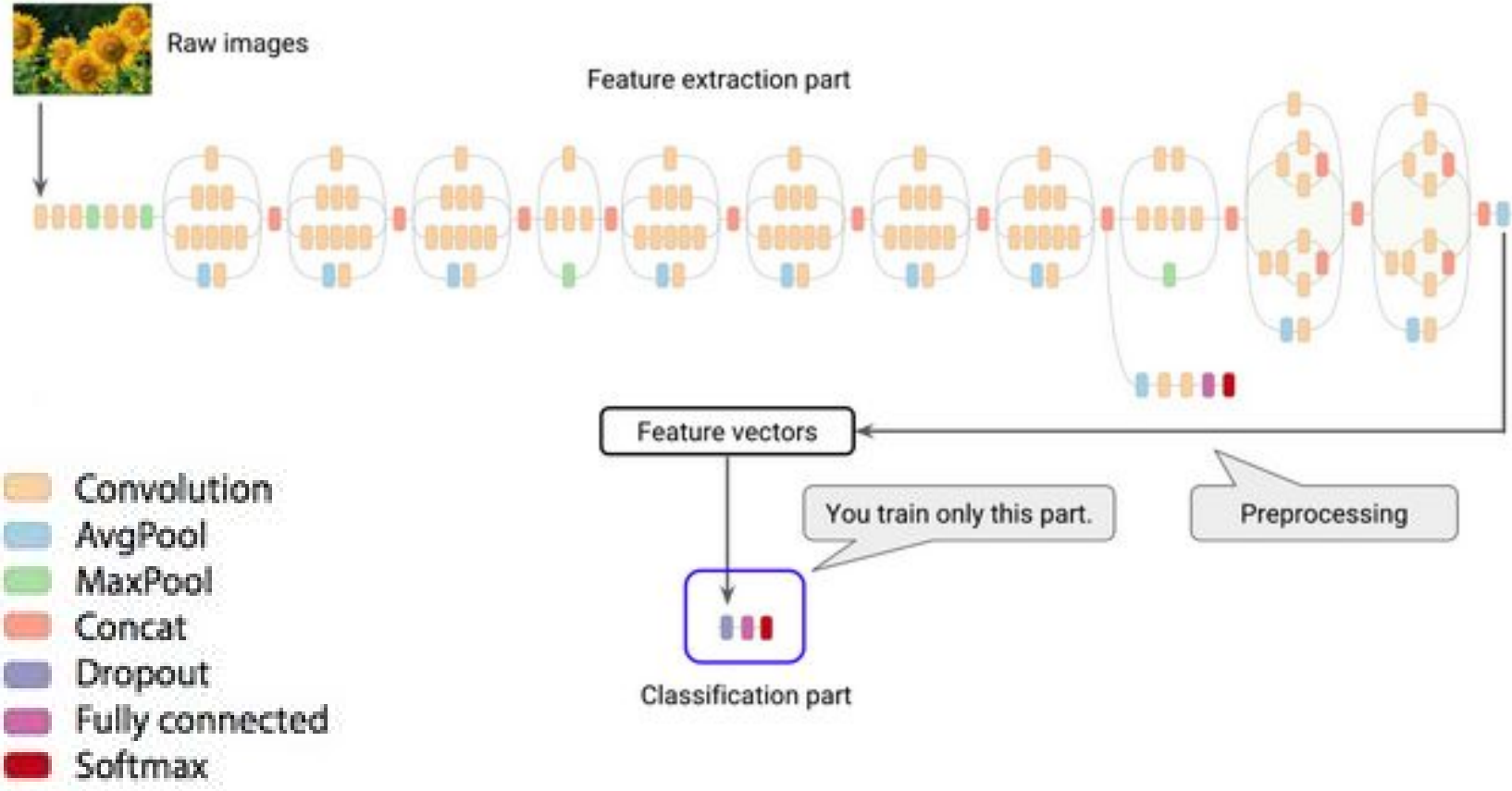
- Performed classification on Alexnet network
- proposed by Alex Krizhevsky
- Used Keras implementation with Theano Backend
- Network architecture consists of 5 Convolutional layers(followed by maxpool and ReLu) and 3 Fully connected Layers(followed by dropout layer)
- Real time Data Augmentation done on Flipped Dataset with Keras Image Generator (improves performance)
- Trained weights for model from scratch
- Used SGD for training with 80 epochs and batch size 40
- Training time 3-4 hours
- Obtained ~72 % accuracy on augmented dataset

AlexNet Architecture



Inception V3

- Performed Transfer Learning on Inception V3 Model, which is trained on the ImageNet.
- **Transfer Learning:** The last fully connected layer of a pre-trained CNN is removed and treated as a feature extractor for the new dataset. Once we have successfully extracted all the features for all images, we train a classifier on the new dataset.
- Keras Implementation
- **Training Results:**
- Epoch : 5, Batch size : 10, Training time: 6-7hrs
- Training accuracy on Complete Dataset: 73%
- Training accuracy on augmented dataset: 72%


Raw images
Feature extraction part
Feature vectors
You train only this part.
Preprocessing
Classification part
Convolution
AvgPool
MaxPool
Concat
Dropout
Fully connected
Softmax

MobileNet

- Open-Source Models for Efficient On-Device Vision.
- MobileNet are optimized to be small, faster and efficient. But have lower accuracies.
- Performed Transfer learning on MobileNet. A pre-trained model is downloaded, and we added a new final layer. The new Layer is trained on the diabetic retinopathy dataset.
- Training result:
- **Epoch : 500, Training time: 1-2hrs**
- **Accuracy on Complete Dataset: 34%**
- **Accuracy on Augmented Dataset: 36%**

VGG16 Net

- Introduced in 2014-In the paper:

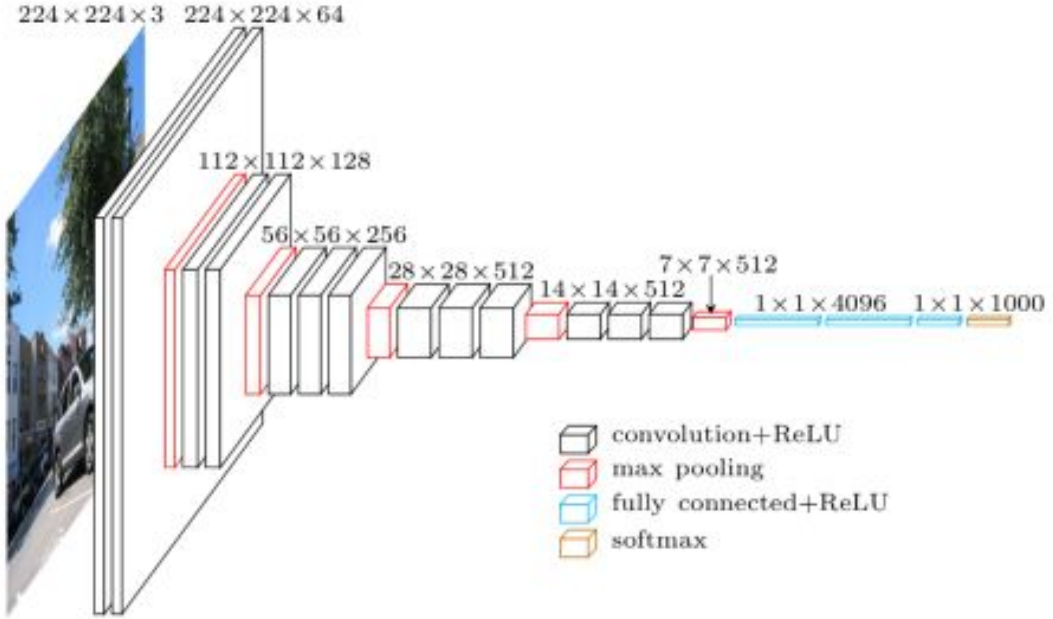
Very Deep Convolutional Networks for Large Scale Image Recognition.

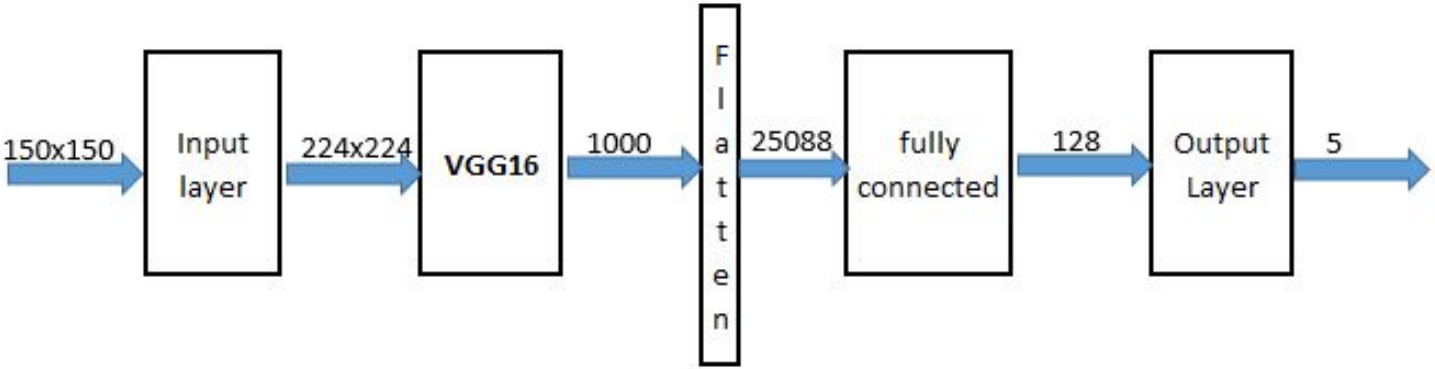
- network is characterized by its simplicity
  - *3×3* convolutional layers stacked on top of each other in increasing depth.
  - Reducing volume size is handled by max pooling
  - Two fully-connected layers, each with 4,096 nodes are then followed by a softmax classifier (above).
- Observations:
  - Slow to train. Huge memory
  - Poor performance on the dataset

VGG16 Architecture

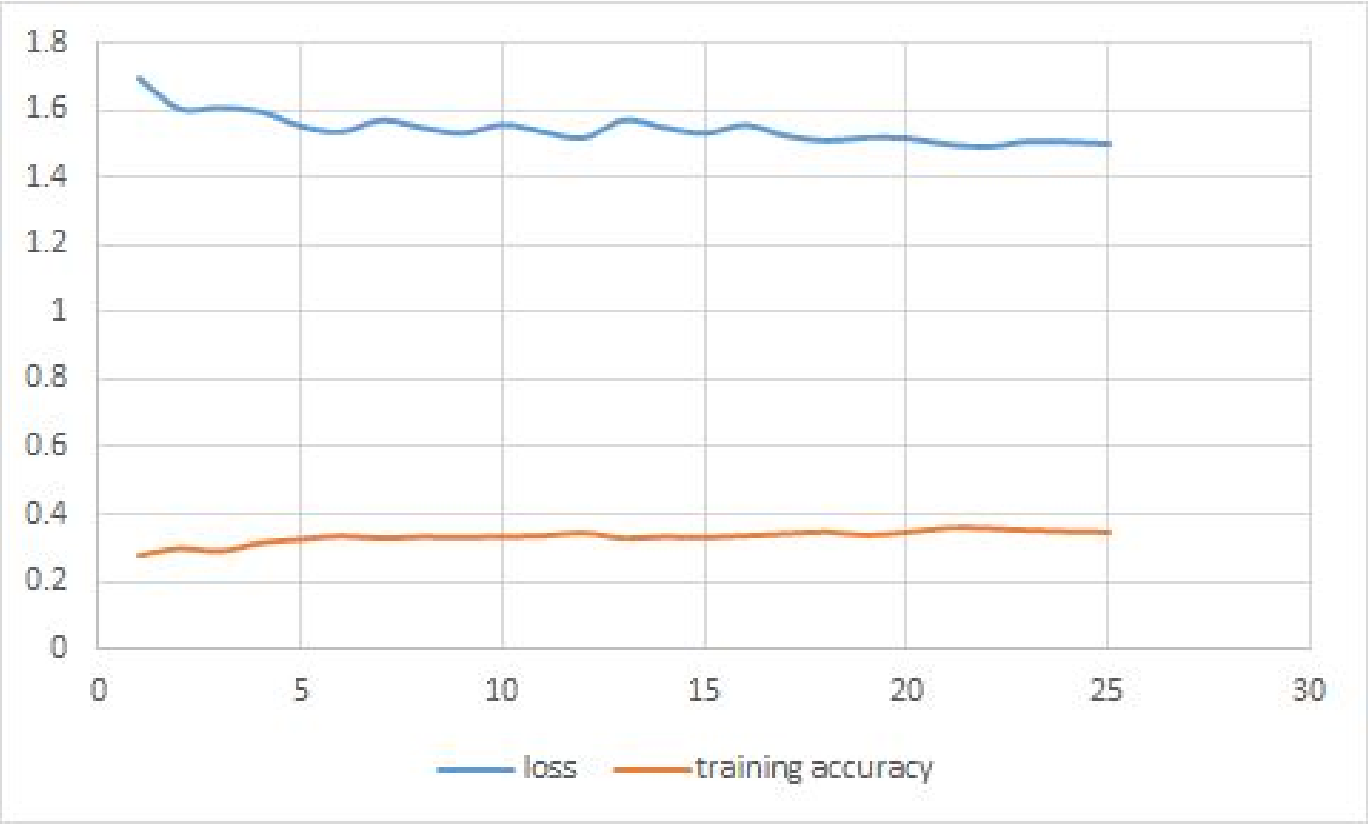
Epoc: 25
Batch Size: 64
Training time: 10hrs

Accuracy: ~35%





Training Loss and Accuracy



Result

Accuracy

Model	Accuracy
AlexNet	~ 72% (On Flipped Dataset)
VGG Net	~32% (On Original Dataset) ~35.61% (On Flipped Dataset)
Inception V3	73% (On Original Dataset) 72% (On Flipped Dataset)
MobileNet	34% (On Original Dataset) 36% (On Flipped Dataset)

Questions!?