On the Relevance of Very Deep Networks for Diabetic Retinopathy Diagnostics

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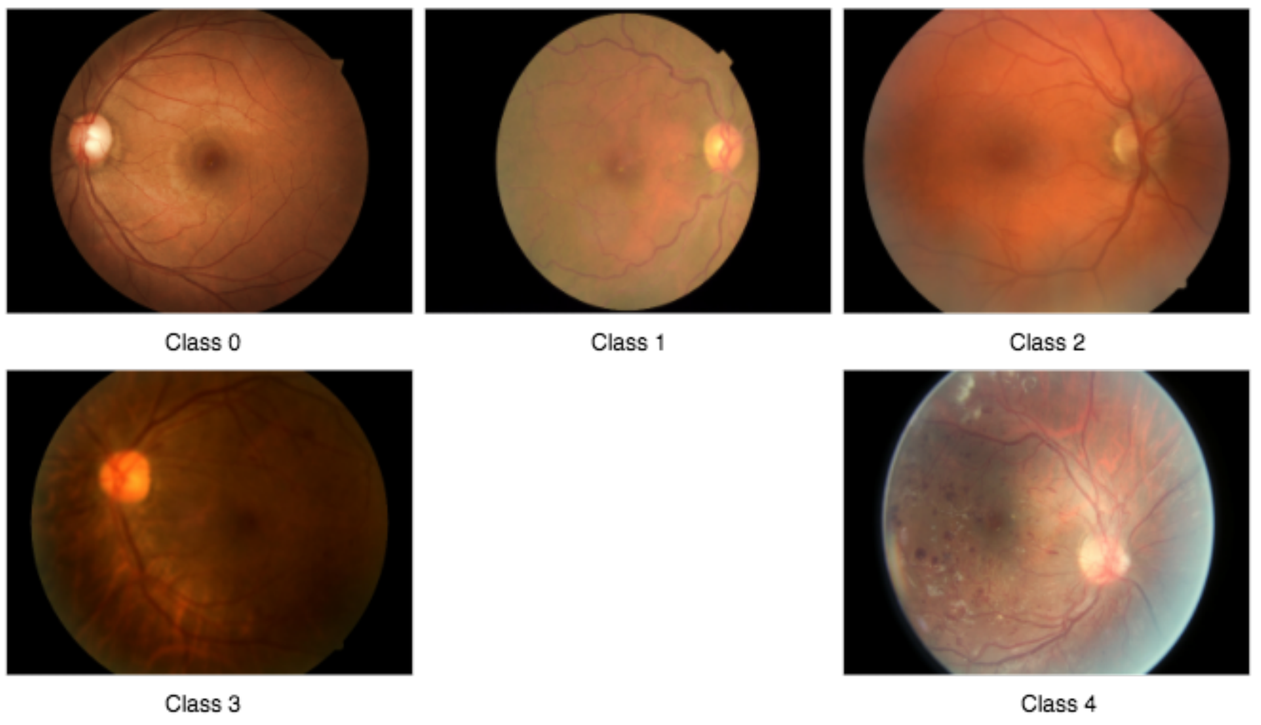
Introduction

- Diabetic Retinopathy (DR), a diabetic complication affecting eyes and having potential to cause severe vision loss.
- Early stages hardly show any perceivable symptoms; if detected early, progression of disease can be curbed.
- Proliferation of fundus image necessitates automatic image classification.
- Binary Classification of fundus images using Convolutional Neural Networks (CNN)

Motivation

- Clinical procedure is time consuming; requires manual assistance.
- Results take time which dissuades people from follow-ups.
- Number of images acquired has increased without concomitant increase in clinicians.
- Fast and automated algorithms can help clinicians; important for tele-medicine and deployment in rural settings.
- Deep architectures take advantage of huge number of images that are available to help facilitate assessment of the disease.

Dataset



EYEPACS Dataset For Kaggle Challenge

- Contains more than 85,000 images.
- Divided into five classes
- Highly imbalanced
- Real world like
- Taken from different cameras

Our Dataset

- Binary: Normal (0,1), Diseased (2,3,4).
- Images are center-cropped to 512x512 and 128x128.

Performance Metric

- Sensitivity: TP/(TP + FN)
- Specificity: TN/(TN + FP)

Approach and Results

Approach

- Class imbalance handled by adaptively replicating the images through time.
- Data augmentation using geometric and color transformations
- Gradient Noise as regularizer.
- Training and experimented on two deep networks: DeepNet and Residual Networks (ResNet).

Results and Future Work

- Proposed methodology shows an improvement over the previous best.
- Addition of gradient noise gives a significant improvement in the sensitivity score.
- Use of Residual Networks increases the performance as the depth is increased.
- Training of ResNets on 512x512 images can improve performance further.

Method	Sensitivity	Specificity	Accuracy
ResNet 18 layer	88	87	87
ResNet 18 layer (G)	90	89	90
ResNet 34 layer	90	88	89.5
ResNet 34 layer (G)	92	91	91
ResNet 50 layer	91	90	90
ResNet 50 layer (G)	93	91	92.5
ResNet 101 layer	94	92	92.5
ResNet 101 layer (G)	96	94	95

Method	Sensitivity	Specificity	Accuracy
State-of-the-art CNN	89	86	88
DeepNet	91	89	90
DeepNet (G)	94	91	93

Method	Sensitivity	Specificity	Accuracy
DeepNet (G)	90	88	89
ResNet 101 layer (G)	96	94	95

G: Gradient Noise

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