Automated Detection of Diabetic Retinopathy using Deep Learning

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INTRODUCTION

- **Diabetic retinopathy (DR)** is a common eye disease which affects <u>one in three Americans</u> with diabetes.
- DR can progress to <u>irreversible vision loss</u> without early diagnosis.
- While binary classification of DR has achieved high accuracy , multinomial classification assessment has challenging, particularly for early stages of disease.

PURPOSE

Develop a DR grading system capable of classifying fundus images based on location, number and type of retinal lesion.
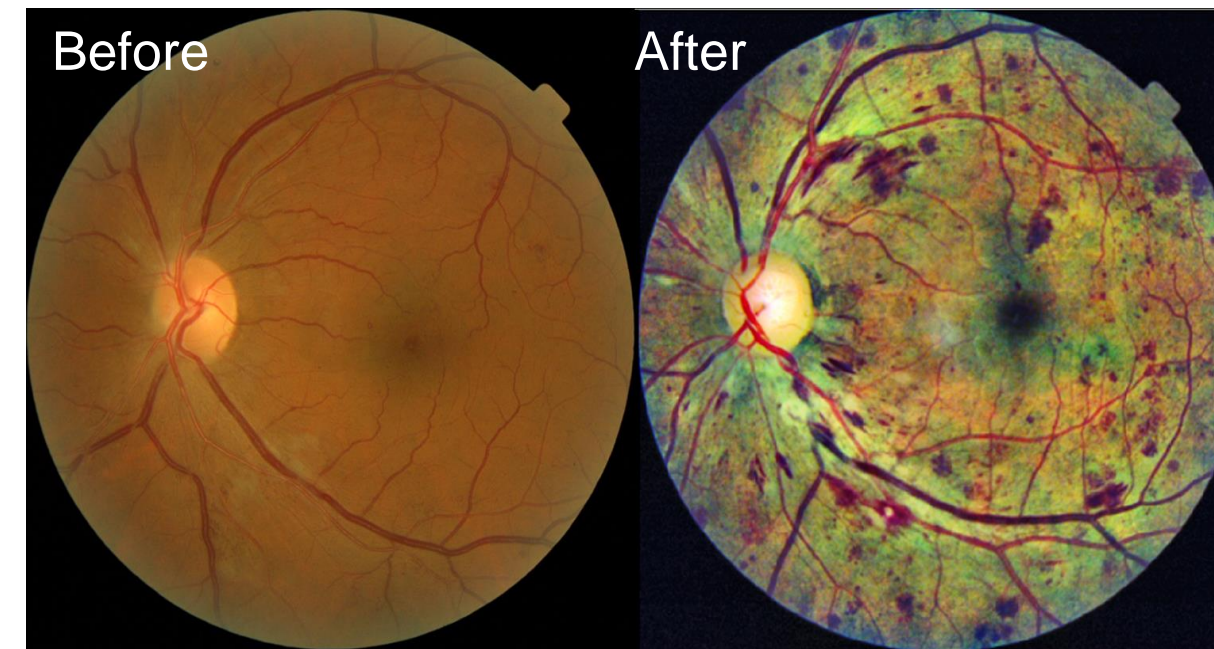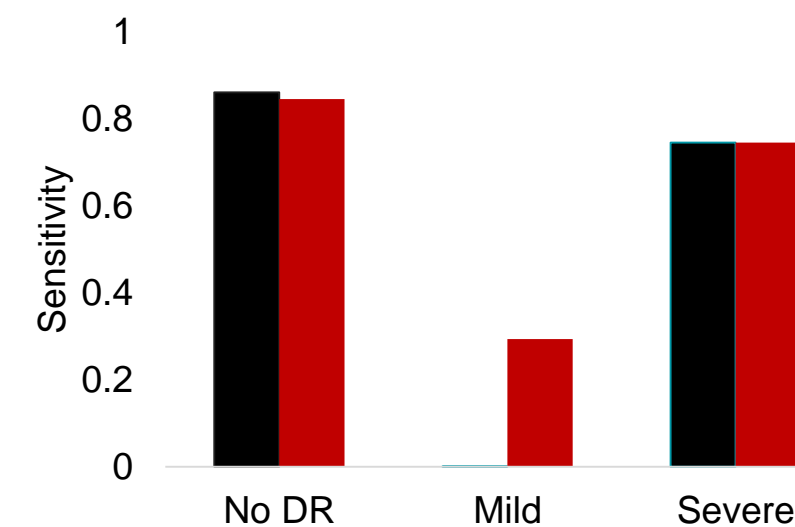

Normal

End Stage

Early Stage

Diagnosis?

Prognosis?
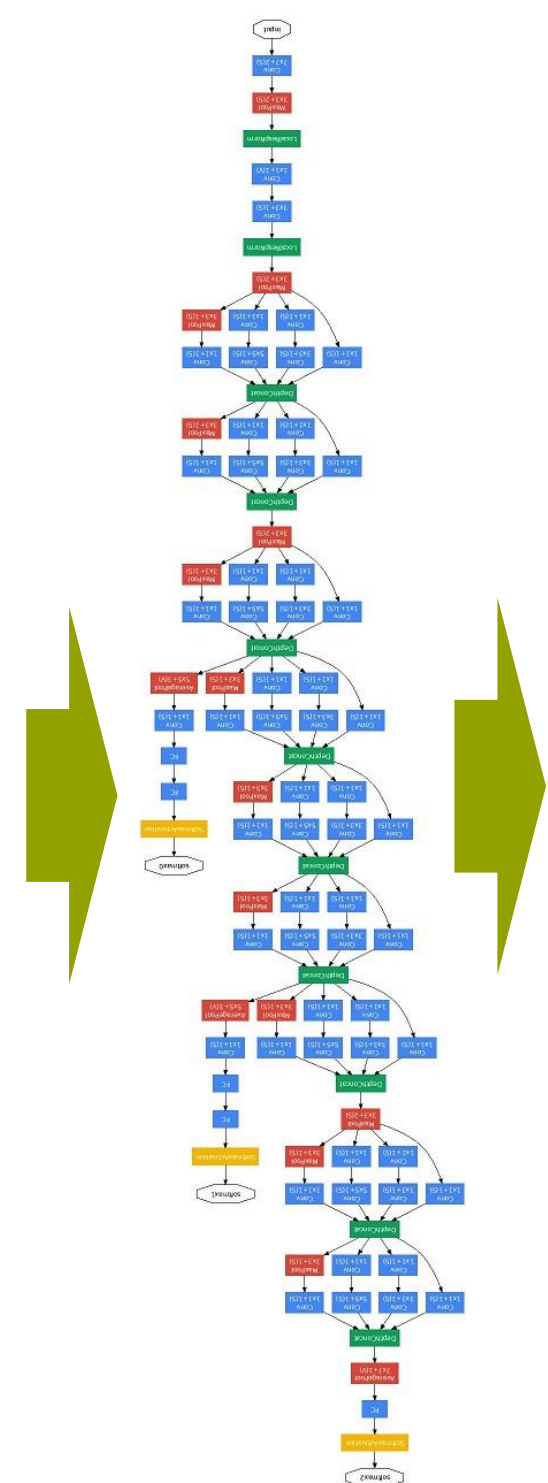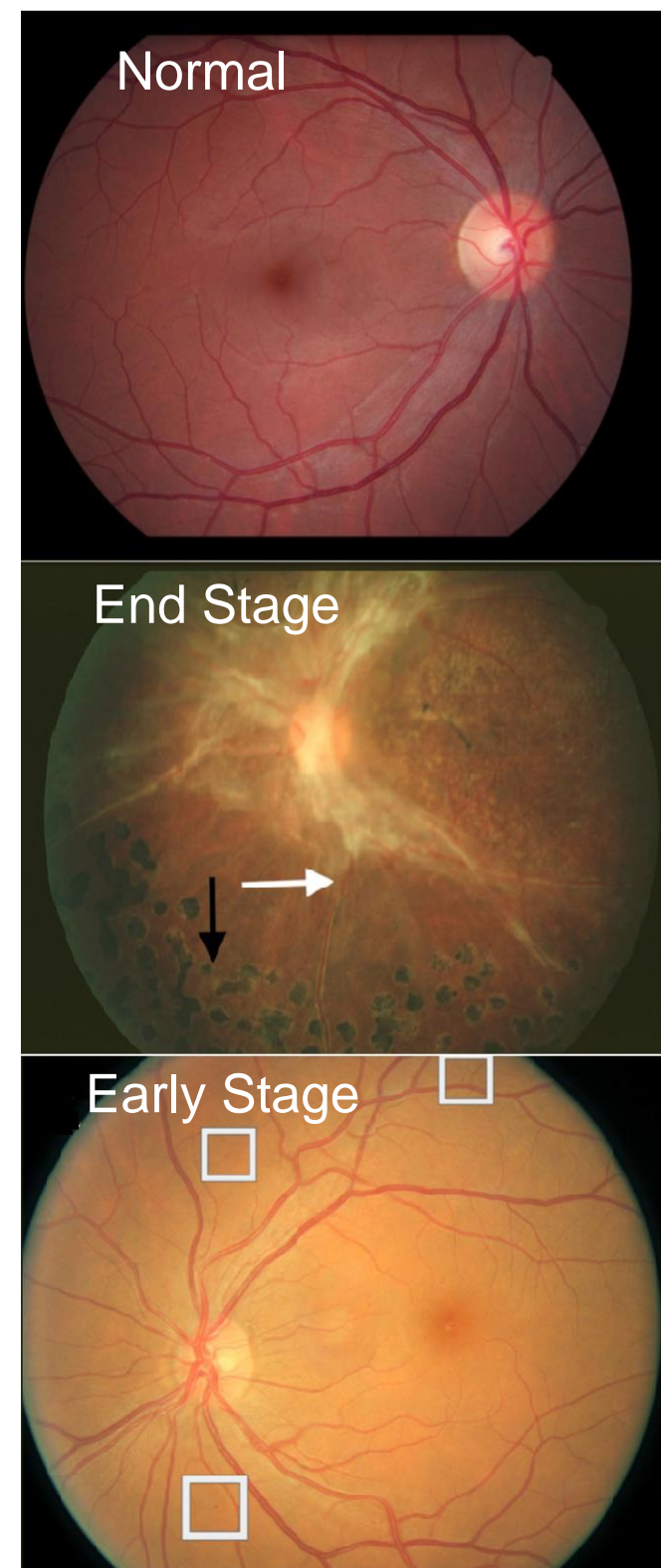
Treatment?

GoogLeNet architecture [8]

RESULTS

Preprocessing

Real-time rotation, flips, and translation to augment data

Before   After

Before and **after** histogram normalization

Binary Class Training

- Binary models (AlexNet, VGG16, and GoogLeNet) were trained and tested on the Kaggle and MMDR dataset
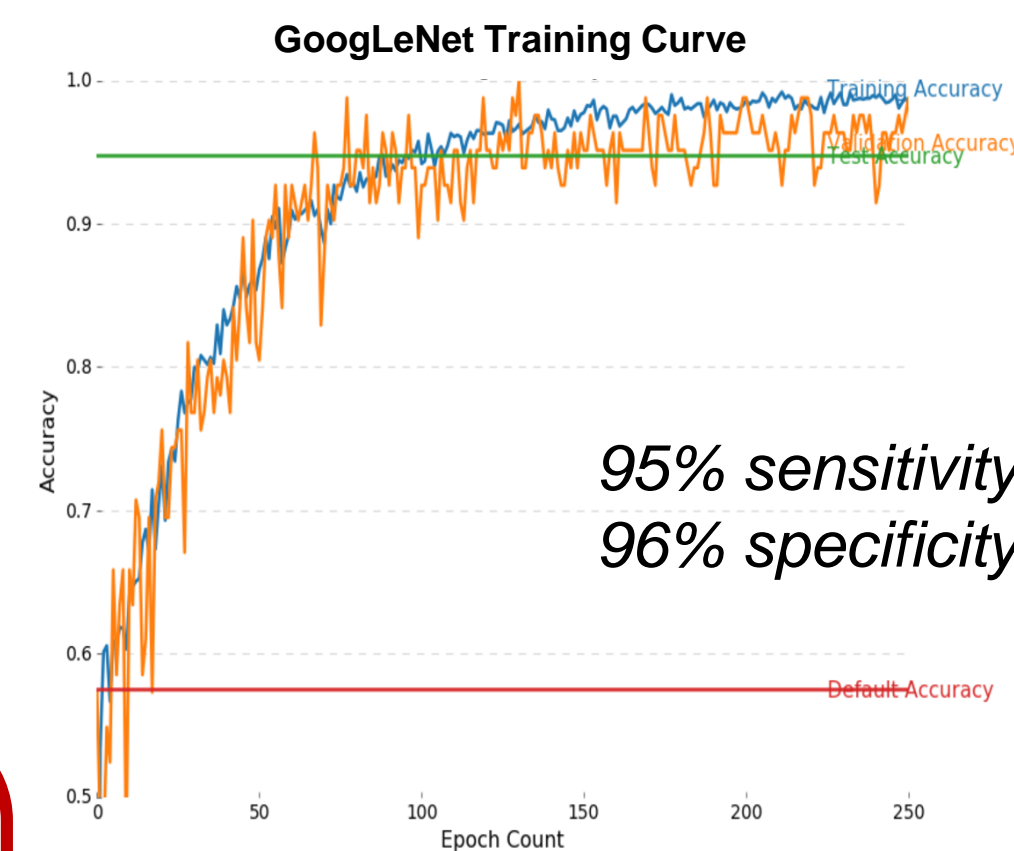- GoogLeNet was the highest performing CNN.

Kaggle Dataset
(n=35k, public dataset)
0 - None, Mild (73%)
1 – Moderate or
    Severe (27%)

GoogLeNet Training Curve

95% sensitivity
96% specificity

Messidor/Mild DR Dataset (MMDR)
(n=1555, mix of public and privately collected data)
- No DR (54%)
- Mild (23%)
- Moderate/Severe (23%)

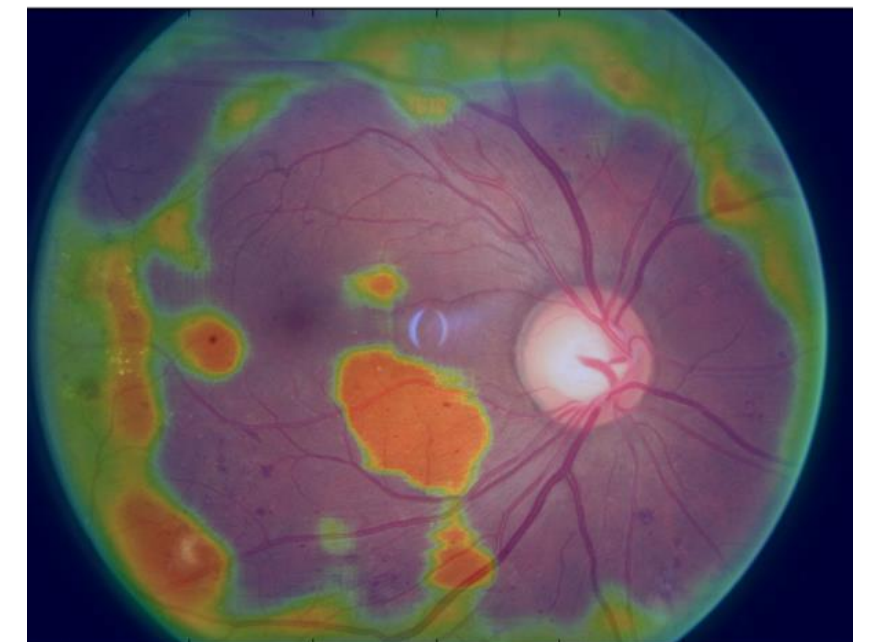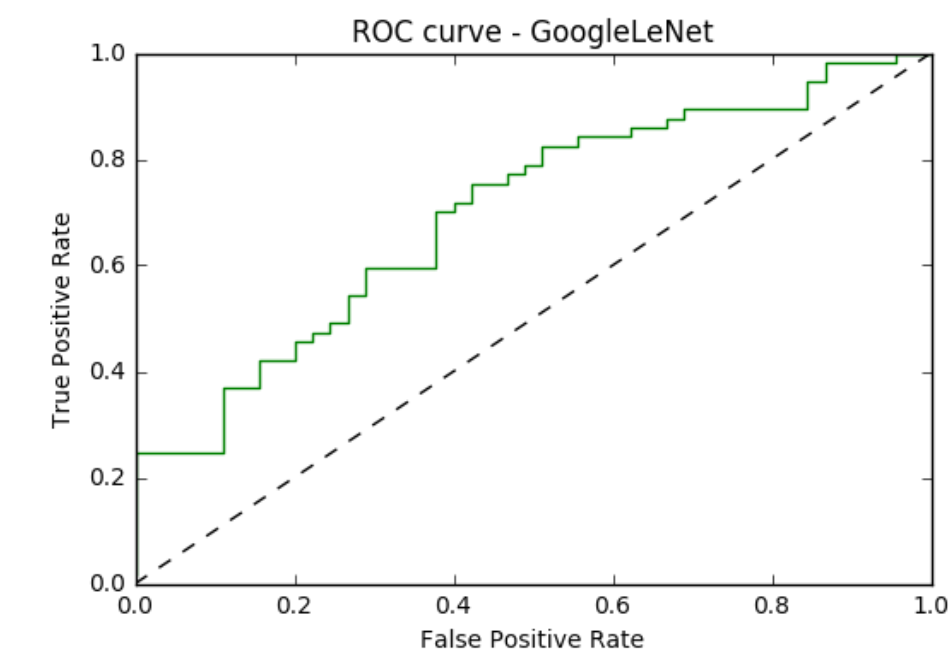|		Predicted	
		DR	No DR
Actual	DR	72	10
	No DR	30	88

90% sensitivity
71% specificity

Visualization

Feature importance heatmap from the sliding window method.
Red = probable disease.
Green = neutral; Clear blue = normal.

Multi Class Training

ROC curve - GoogLeNet

On MMDR dataset
75% overall sensitivity
74% overall PPV
Kappa = 0.536

CONCLUSIONS

- Histogram equalization enhances sensitivity of the classifier for mild cases of DR.
- GoogLeNet CNN as a binary classifier achieves 95% recall, while 3-ary classifier achieves 75% overall recall
- Future steps to improve sensitivity in mild grades involve: boosting, segmentation, and localization steps.

References

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