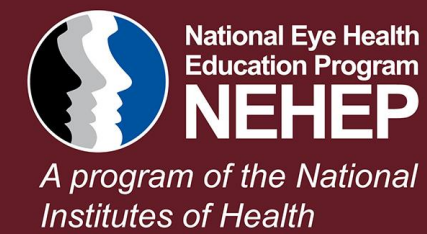


**Adults age 50+ with diabetes
are at higher risk for developing
diabetic retinopathy.**

This disease often has no early symptoms
but can be detected with a comprehensive
dilated eye exam.



www.nei.nih.gov/diabetes



Photo by © [National Eye Institute](#)

DEEP LEARNING PROJECT

DETECTING DIABETIC RETINOPATHY

Sandra Paredes

INTRODUCTION

- ▶ **Motivation:** Diabetic retinopathy clinical trials need classify thousands of images with the correct diagnosis. ^[1]
- ▶ **Research Question:** How well can a neural network diagnose stages of diabetic retinopathy?
- ▶ **Impact Hypothesis:** Accelerate the National Eye Institute's evaluation of clinical trial data and streamline publishing results.

A simulated view of a person with advanced diabetic retinopathy.

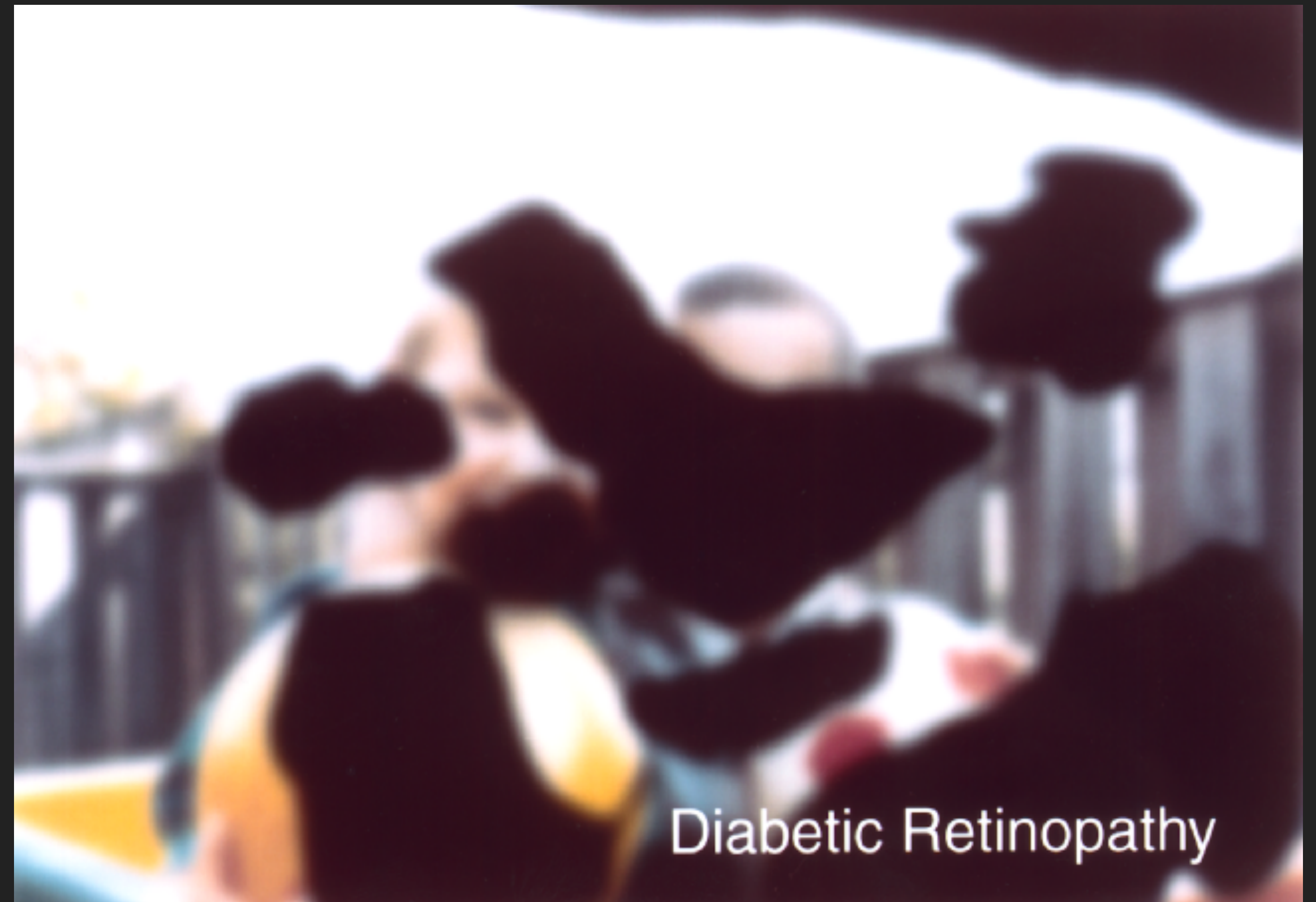


Photo by © [National Eye Institute](#)

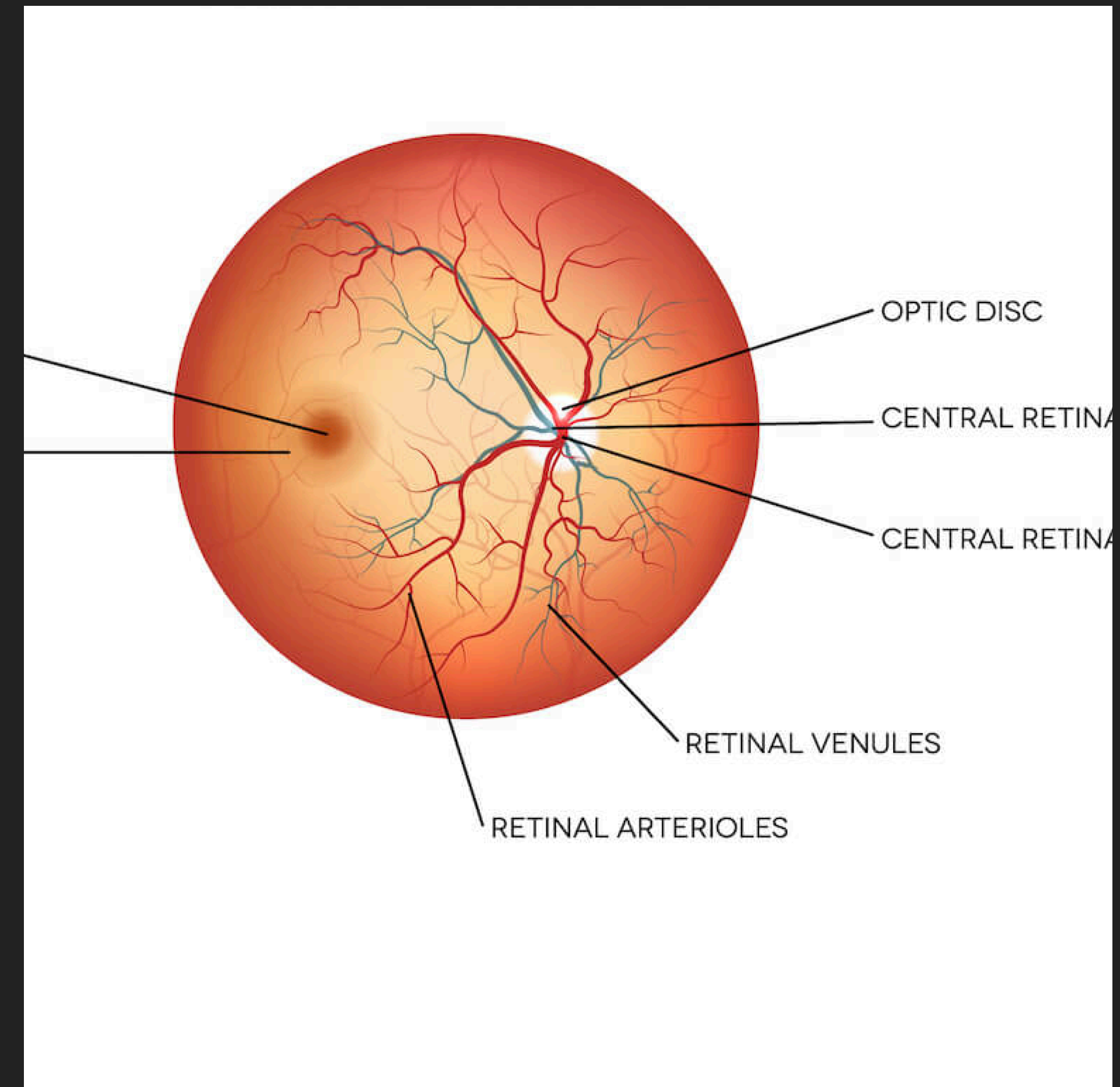
METHODOLOGY

Dataset

- Diabetic Retinopathy 2015 Data [2]
 - Images = 35,000
- Classes (diagnoses):
 - Normal
 - Mild, Moderate, Severe, Proliferative

Preprocessing

- Resize
- Address class imbalance
- ImageDataGenerator
- Data Augmentation



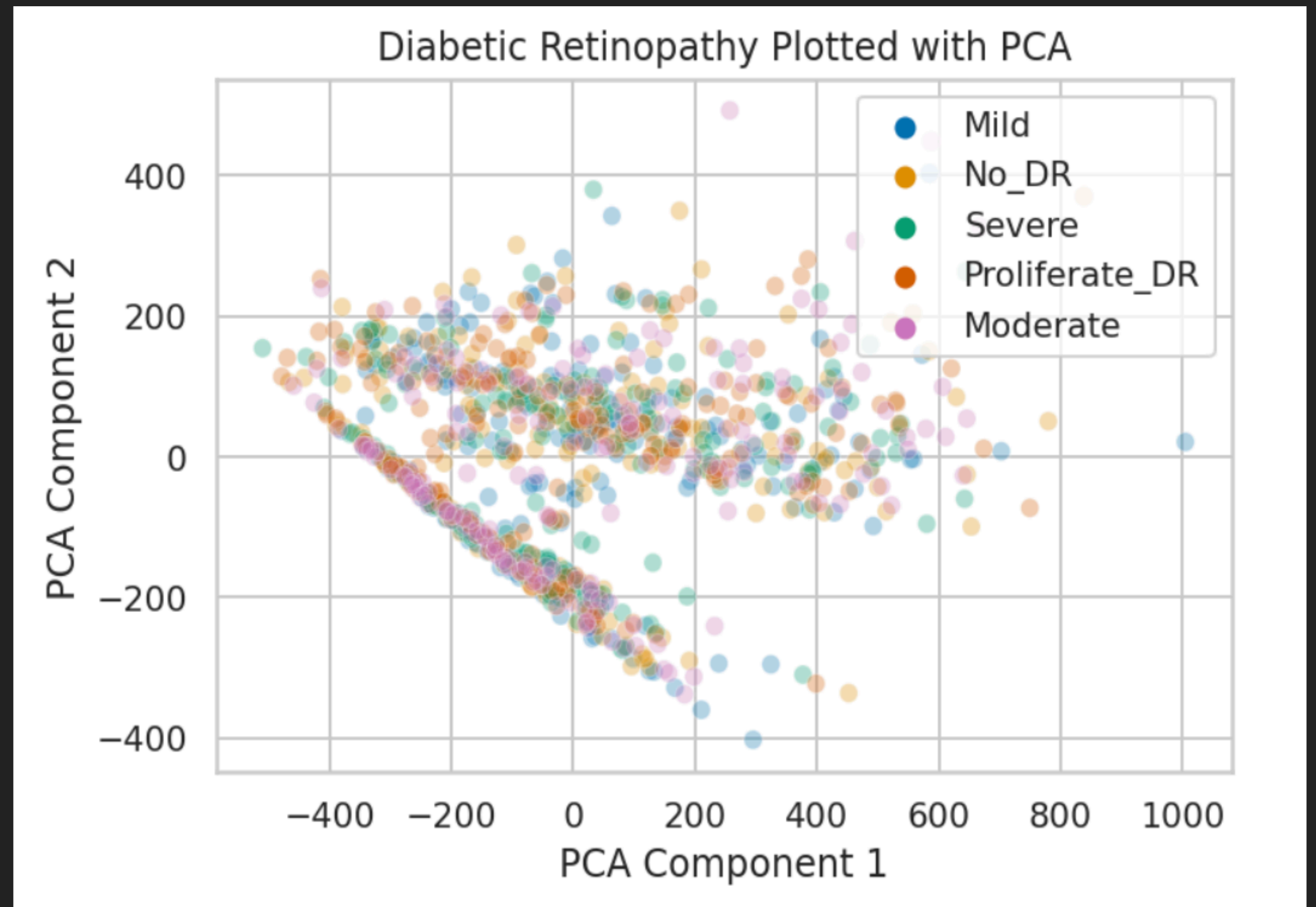
Normal Healthy Retina

METHODOLOGY

► Model Approach

- Do we need a deep learning model?
- Can logistic regression accomplish this task?
- Deep learning may classify images better.

Figure 1.



RESULTS

▶ Deep Learning Models

▶ Neural Network

- ▶ accuracy = 0.34
- ▶ val_accuracy = 0.36

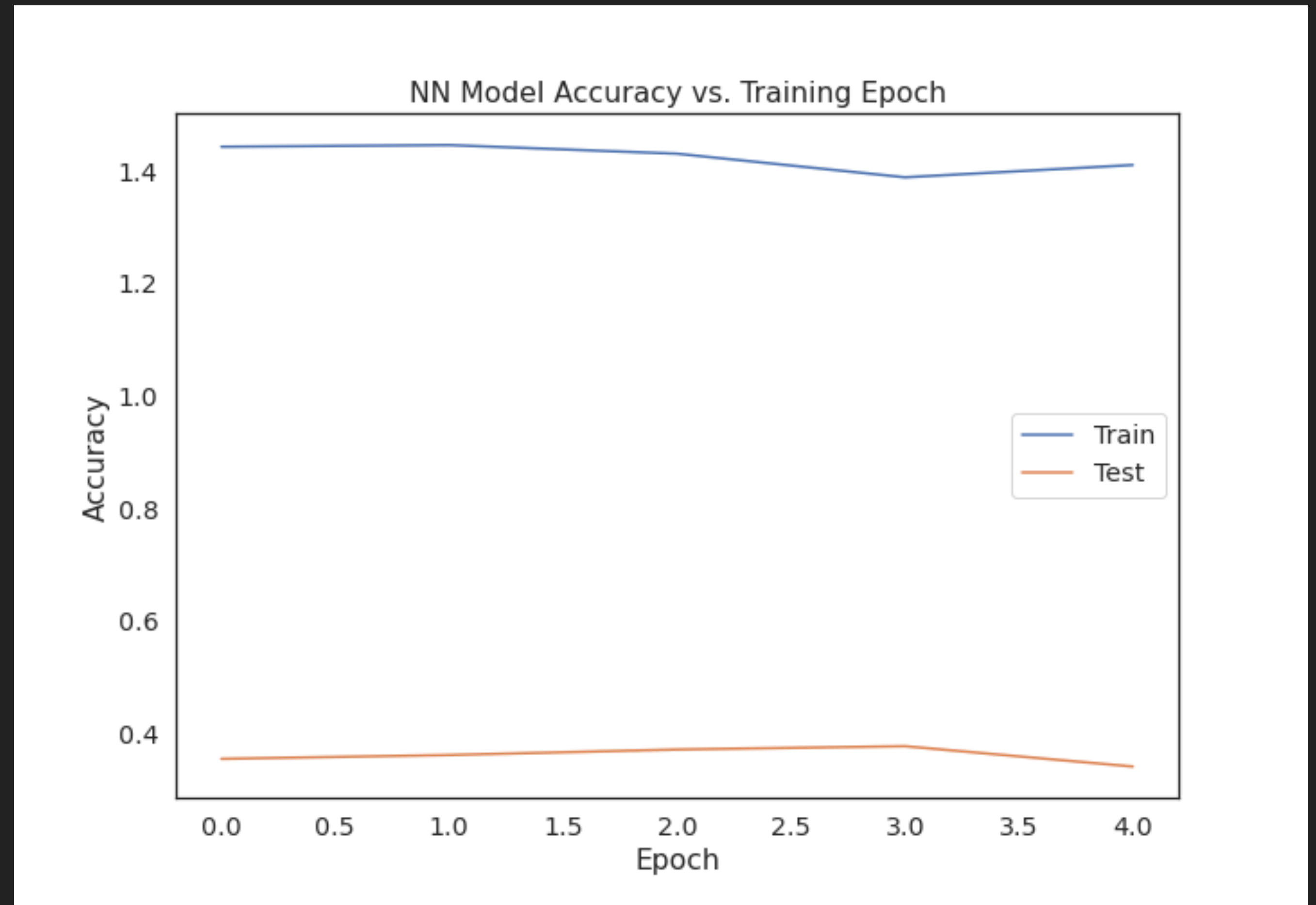
▶ Convolutional Neural Network

- ▶ accuracy = 0.35
- ▶ val_accuracy = 0.53

▶ VGG16

- ▶ accuracy = 0.33
- ▶ val_accuracy = 0.51

Figures 2-4.

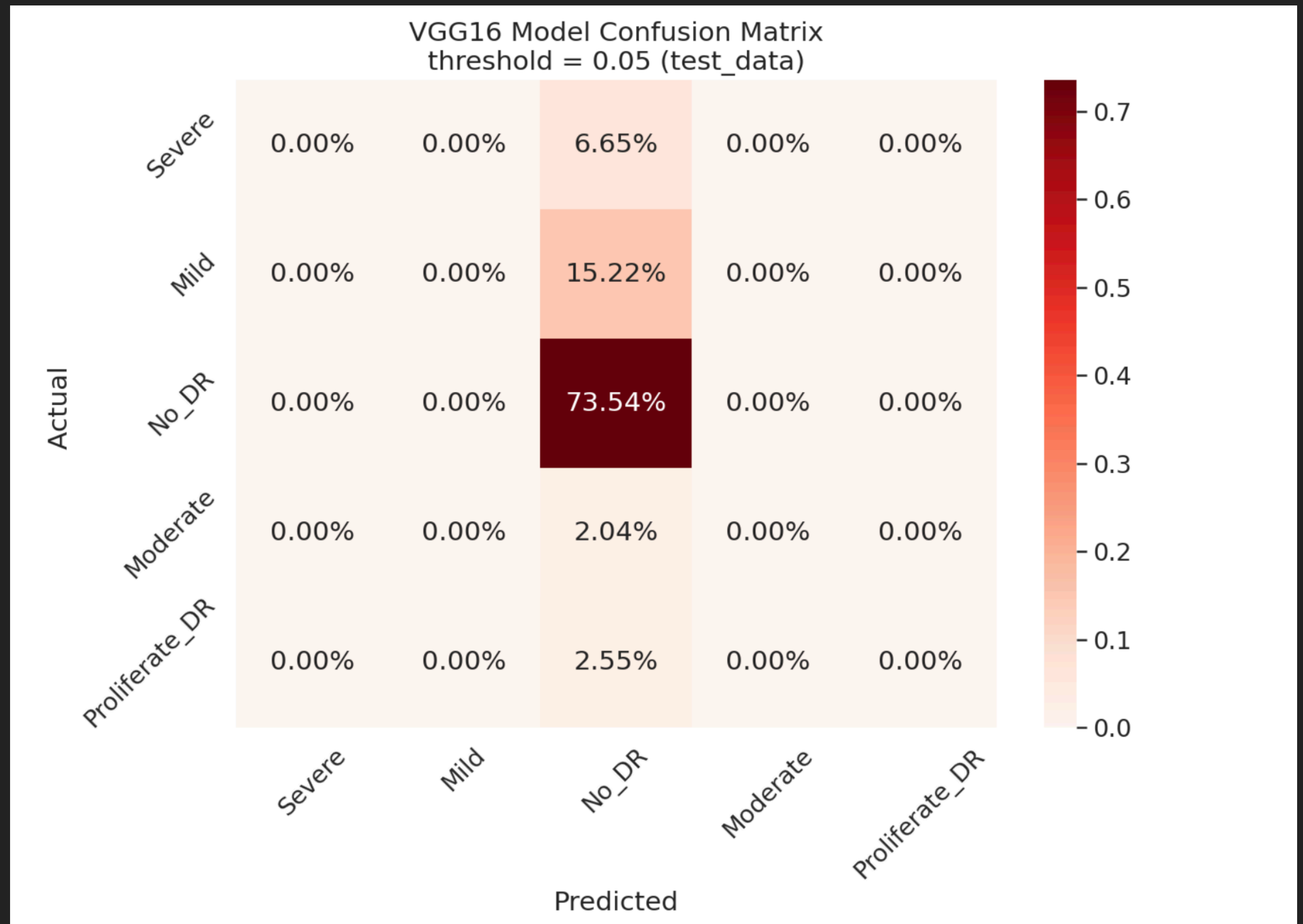


RESULTS

► Predictions

- How well did the VGG16 model predict?
- Predicted all images to be one class (class varied).
- Full data set: 👍
 - ~70% correct
- Select data set: 👎
 - ~30% accuracy

Figures 5-6.



CONCLUSIONS

► **Insights**

- The large class imbalance masked the model's performance at first.
- Data augmentation did not improve predictions.
- The variability of the images is too large for the model to learn.



Photo by © [National Eye Institute](#)

FUTURE WORK

- ▶ Preprocess image data with OpenCV to standardize image features ^[3]
- ▶ Test various pre-trained models
- ▶ Random oversampling and undersampling

Neural circuits in the retina.

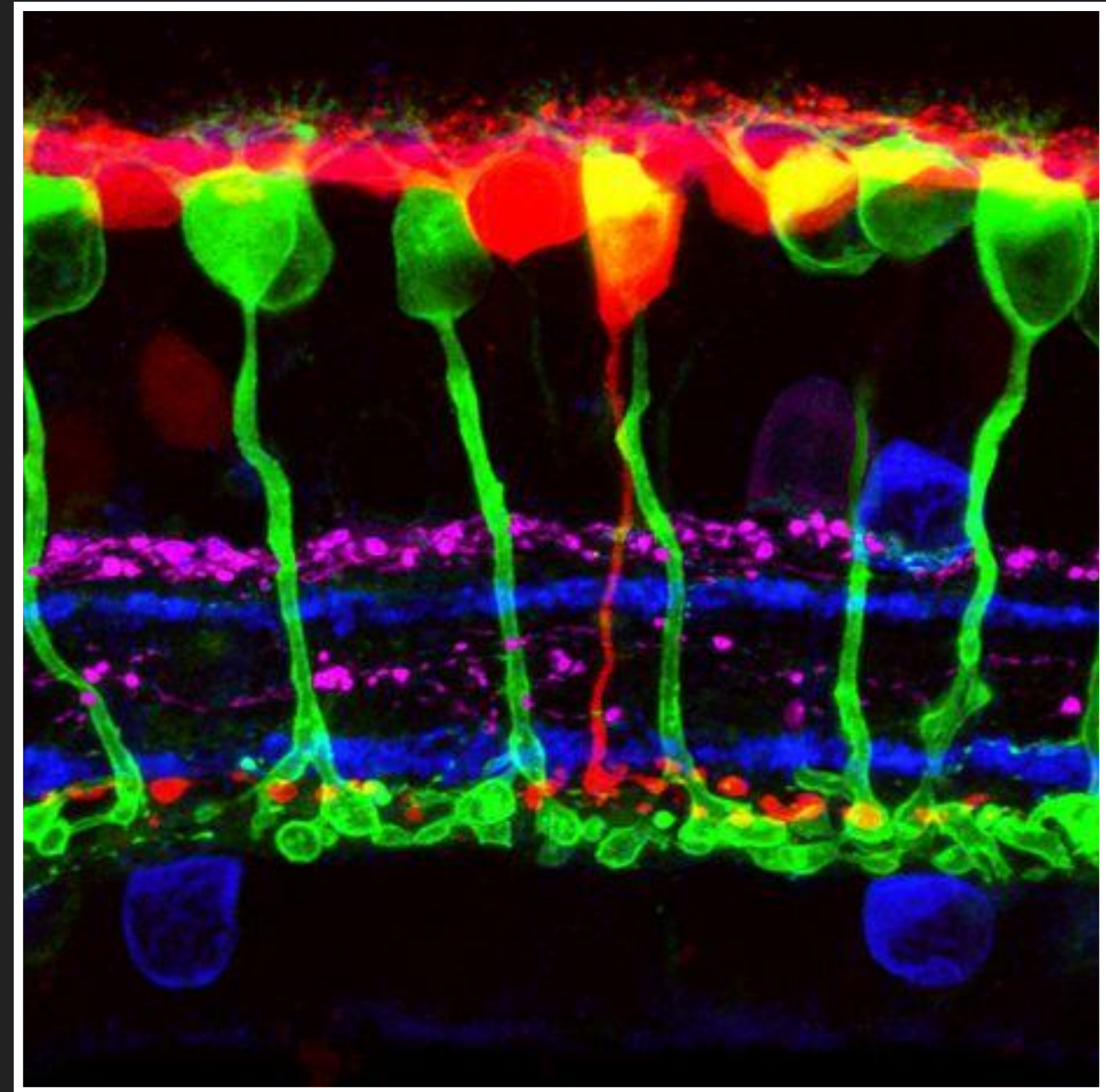


Photo by Wei Li, © [National Eye Institute](#)

APPENDIX

- ▶ Summary, data, and slides are available at github.com/slp22/deep-learning-project

Dr. Emily Chew, Director of the NEI Division of Epidemiology and Clinical Applications



Photo by © [National Eye Institute](#)

APPENDIX: SOURCES

1. NIH adds first images to major research database: <https://www.nei.nih.gov/about/news-and-events/news/nih-adds-first-images-major-research-database>
2. Diabetic Retinopathy 2015 Data Colored Resized: <https://www.kaggle.com/datasets/sovit Rath/diabetic-retinopathy-2015-data-colored-resized>
3. Competition report (min-pooling): <https://www.kaggle.com/c/diabetic-retinopathy-detection/discussion/15801#latest-370950>

APPENDIX

VGG16 Model

