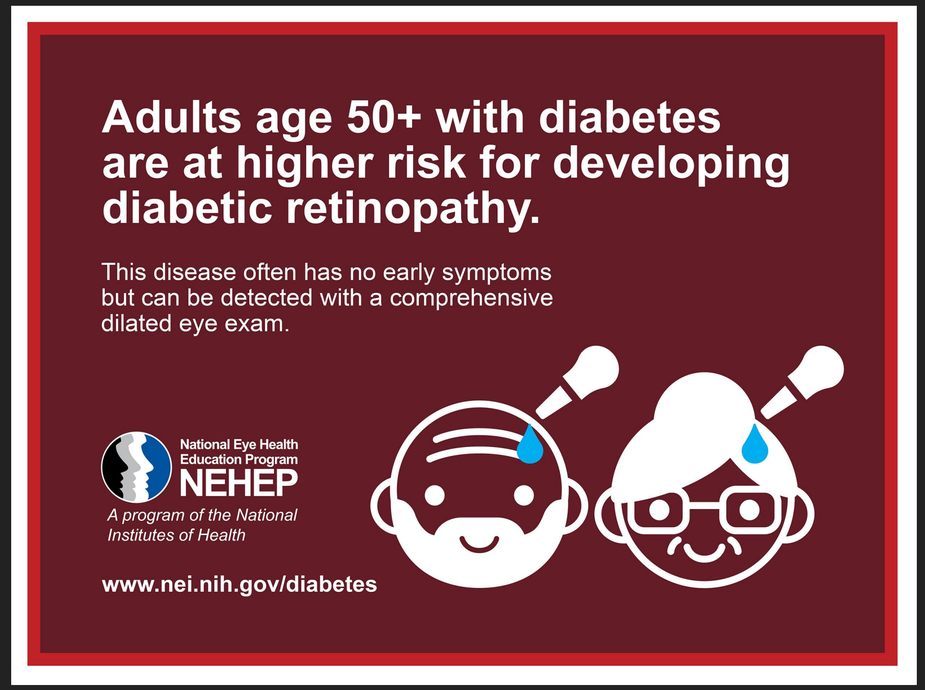


Photo by © National Eye Institute

DEEP LEARNING PROJECT

DETECTING DIABETIC RETINOPATHY

Sandra Paredes

INTRODUCTION

- **Motivation:** Clinical trials generate thousands of images that need to be classified with the correct diagnosis. [1]

- **Research Question:** How well can a neural network diagnose diabetic retinopathy from a retinal image?

- **Impact Hypothesis:** Accelerate the National Eye Institute's research evaluation of retinal clinical trial data, and streamline publishing results.

A simulated view of a person with advanced diabetic retinopathy.

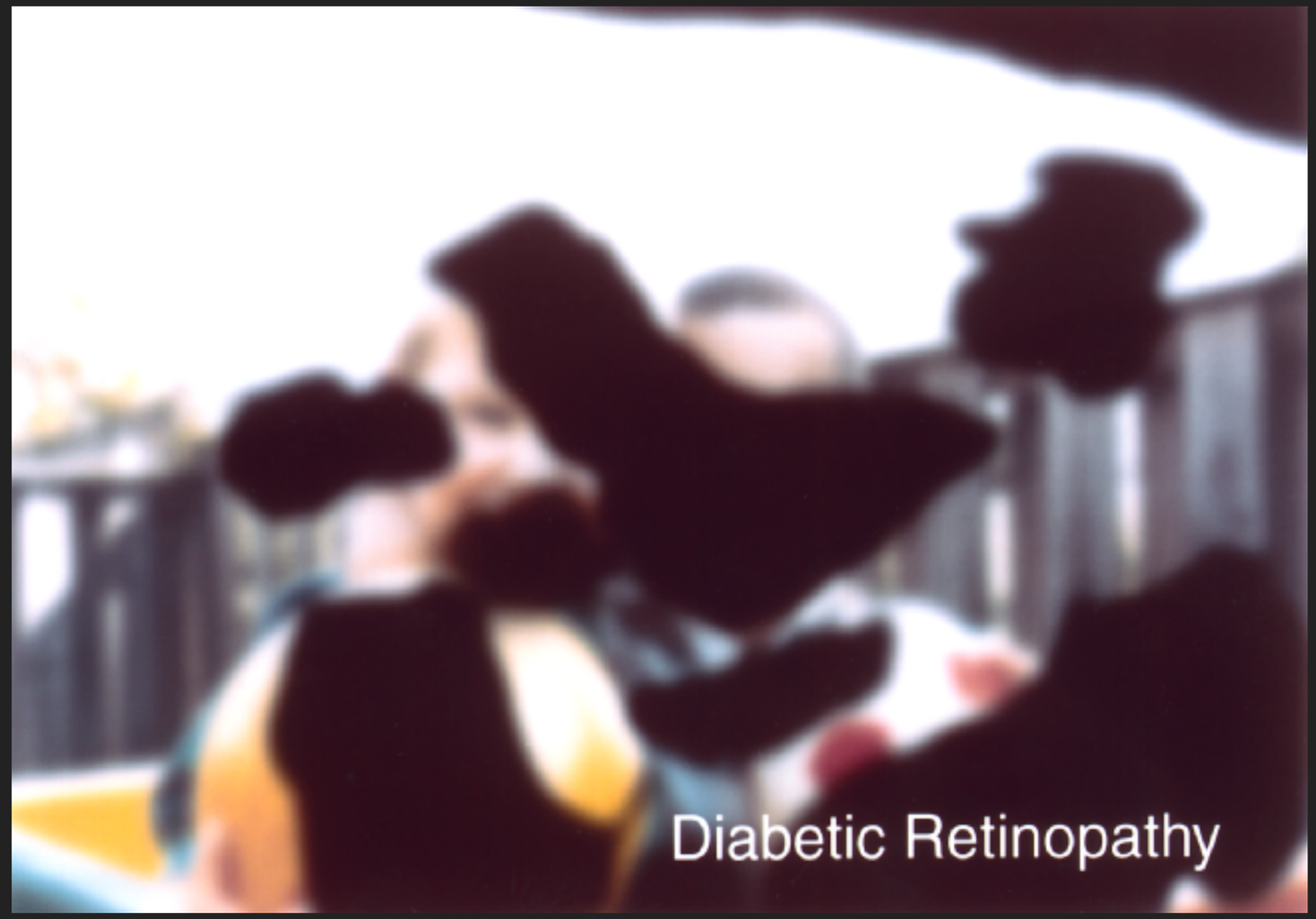


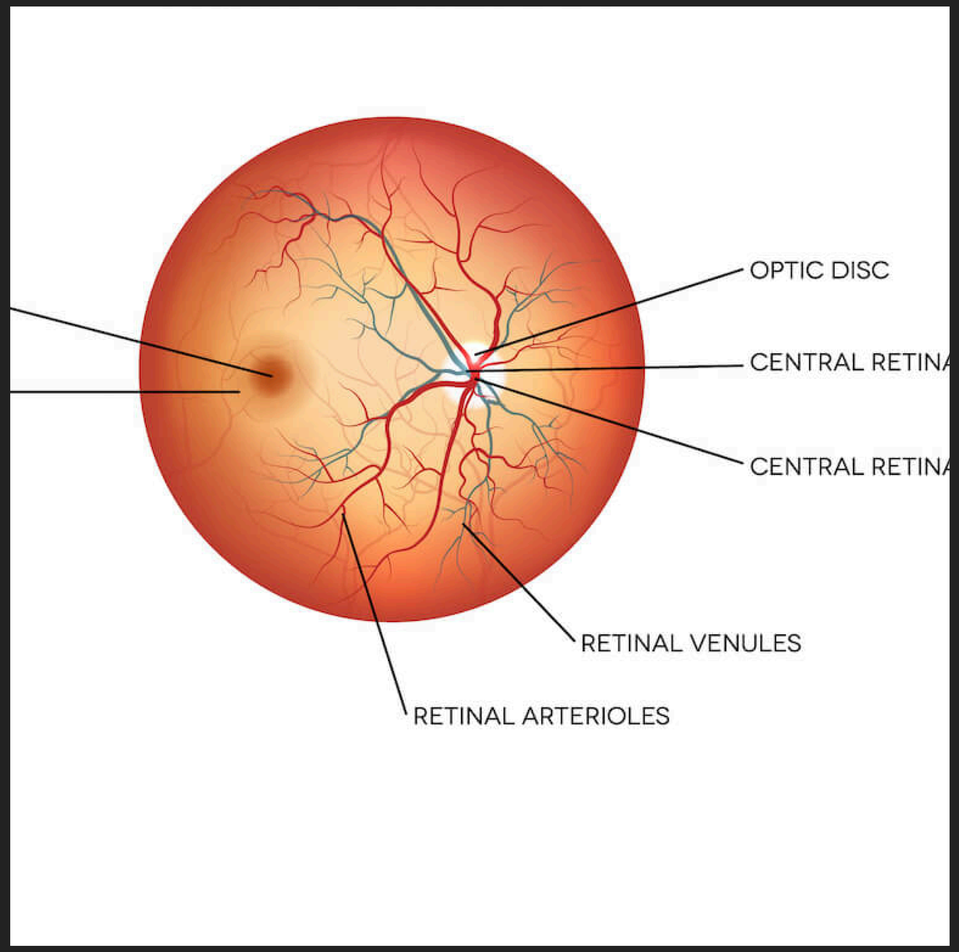
Photo by © National Eye Institute

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

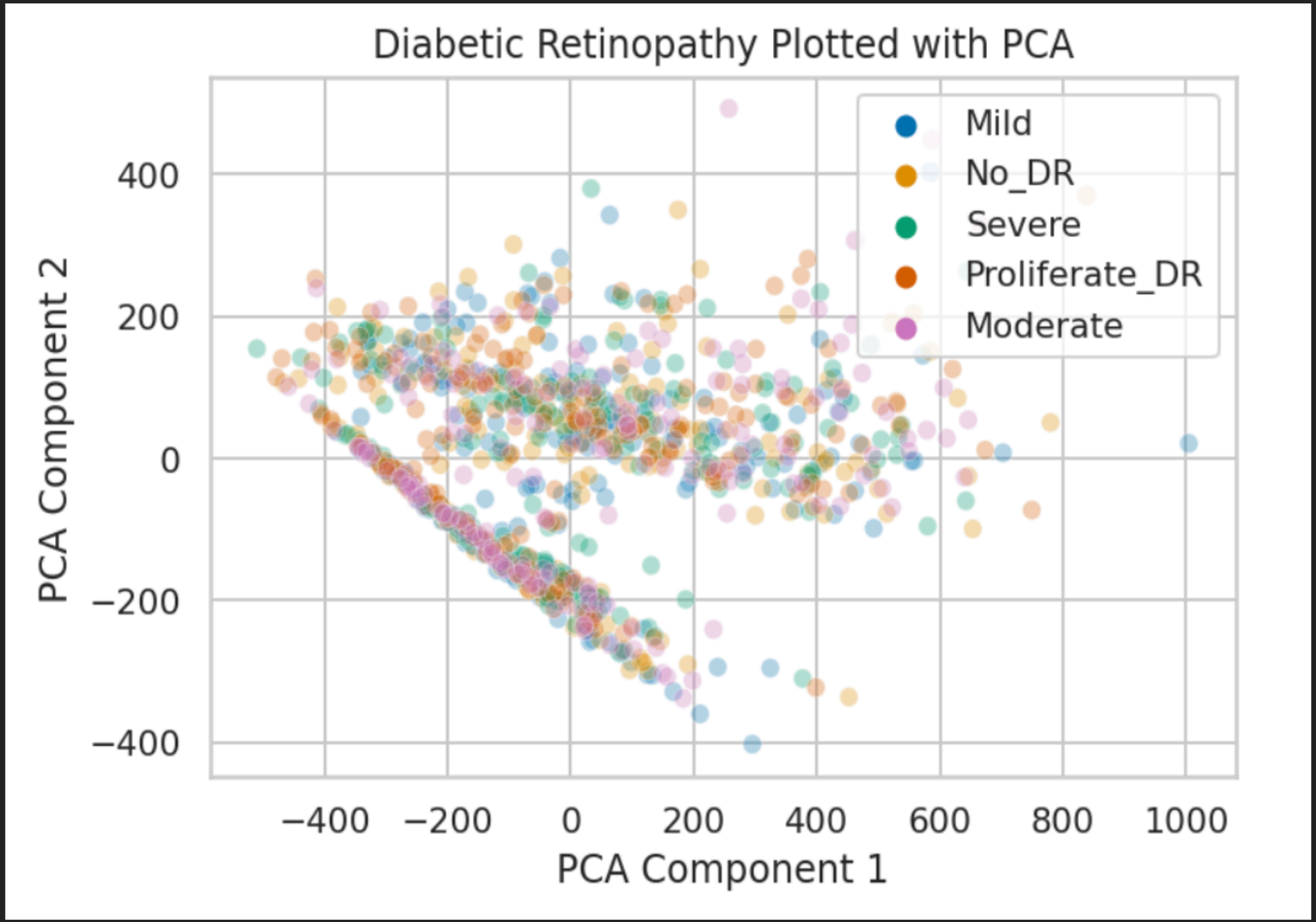


Normal Healthy Retina

METHODOLOGY

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

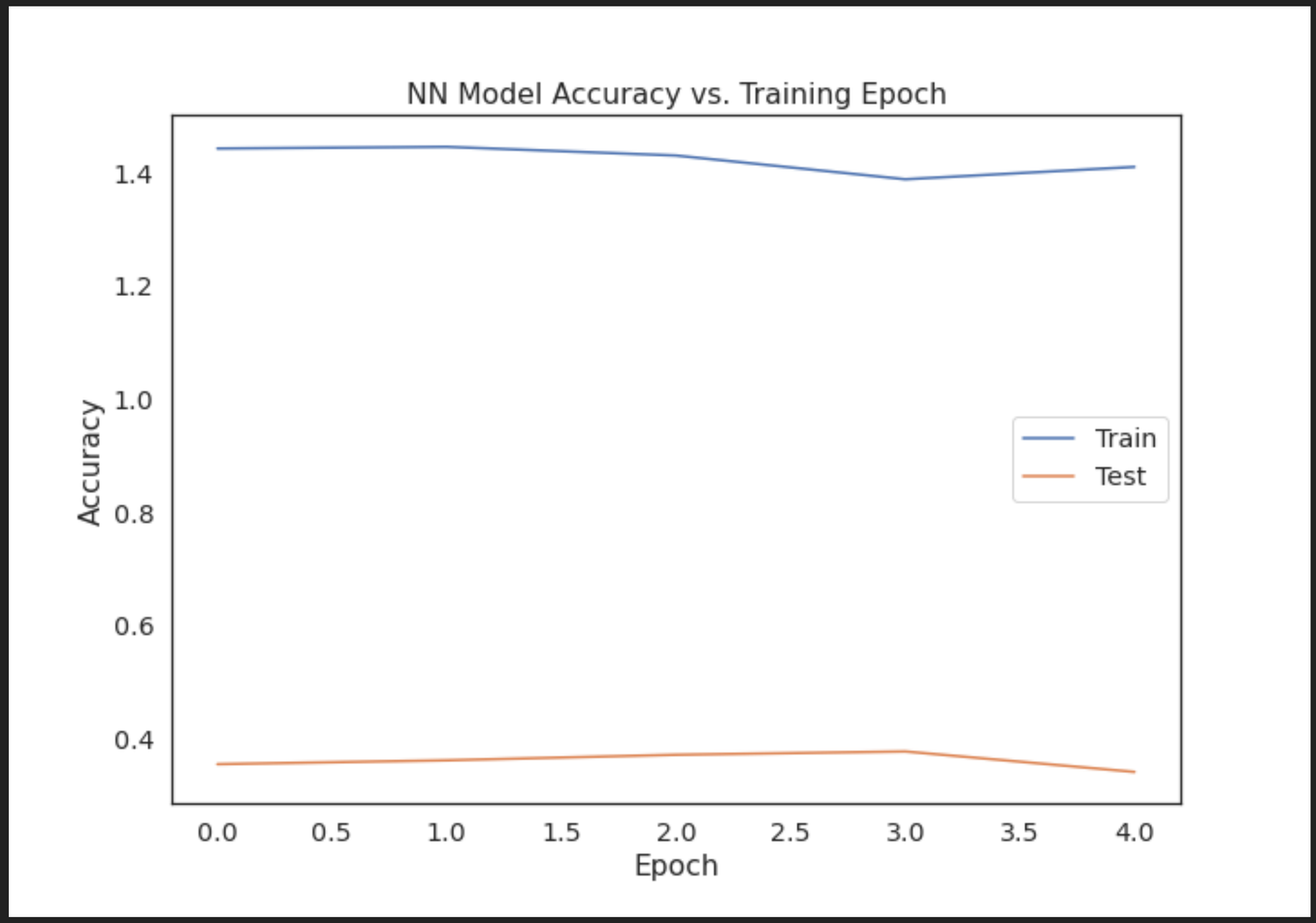
Figure 1.



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

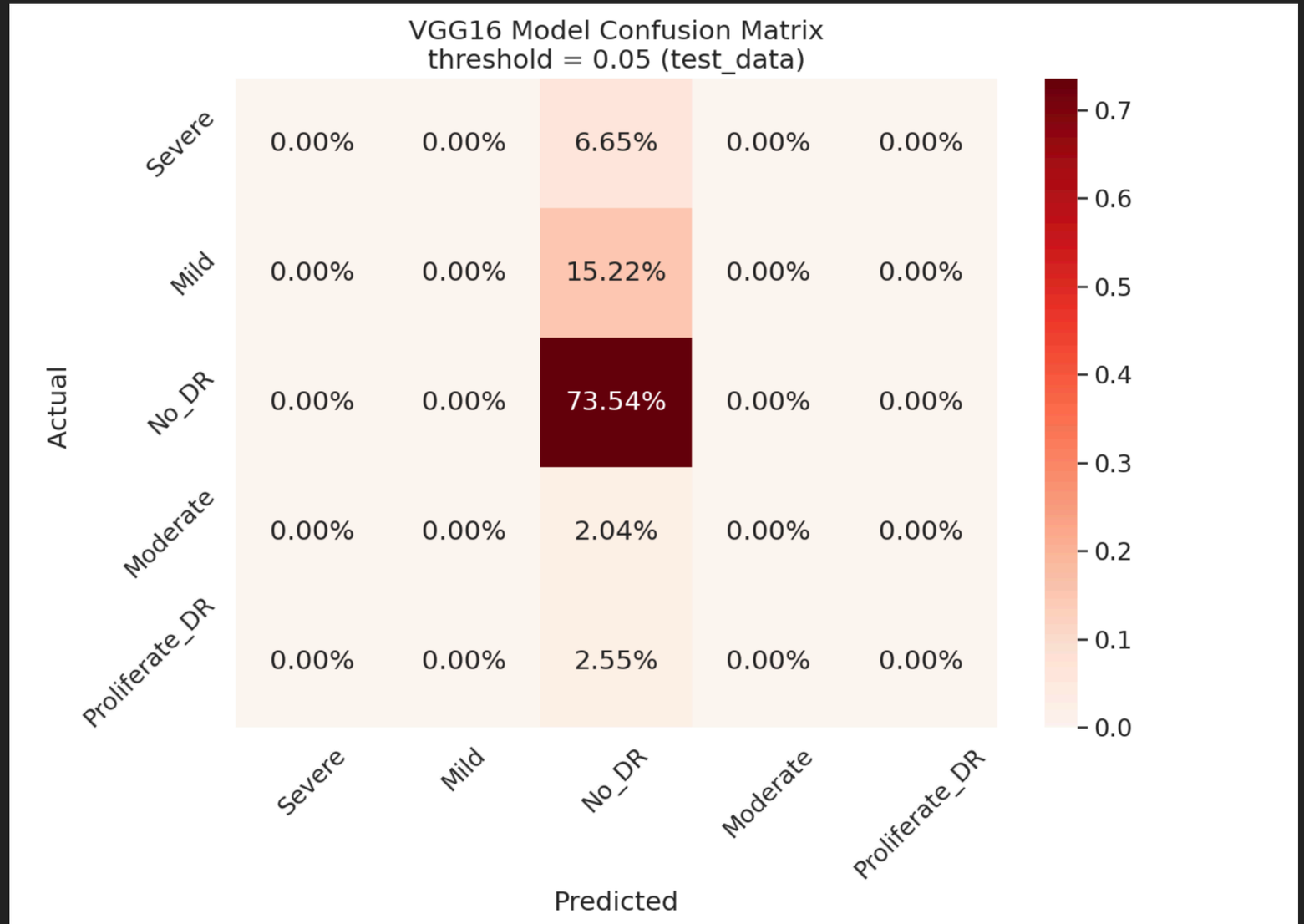
Figures 2-4.



RESULTS

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

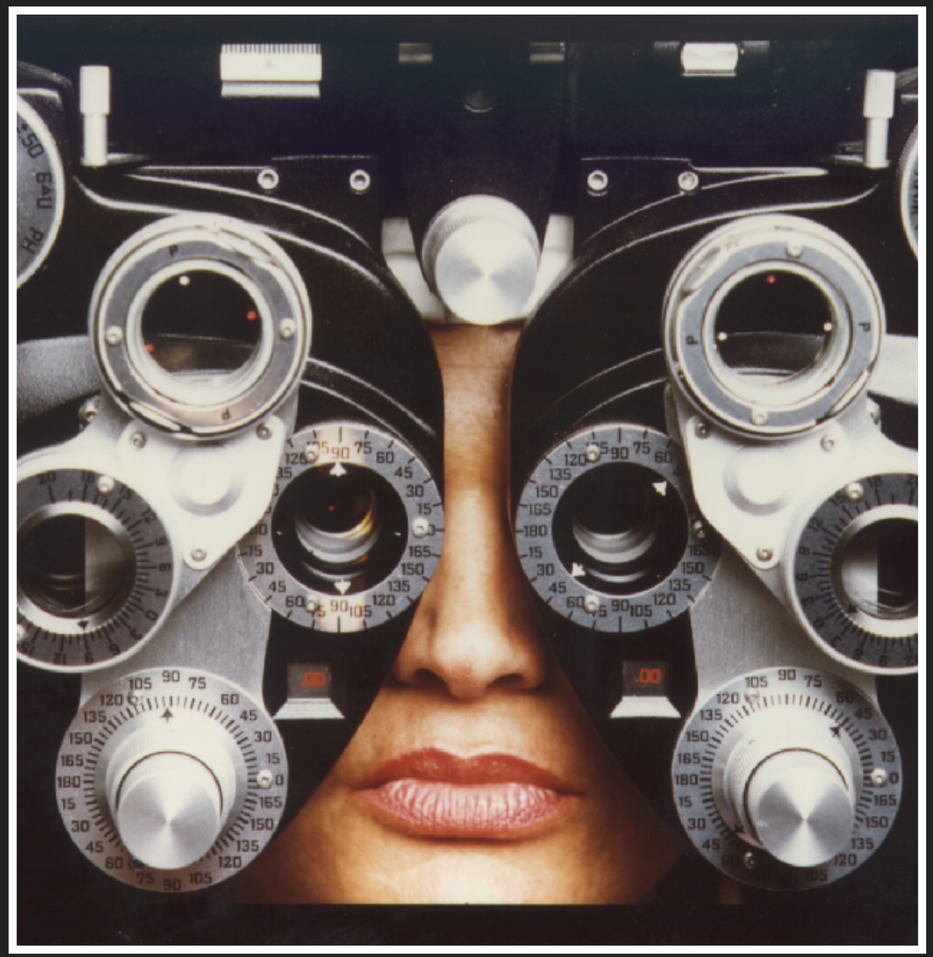


Photo by © National Eye Institute

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.

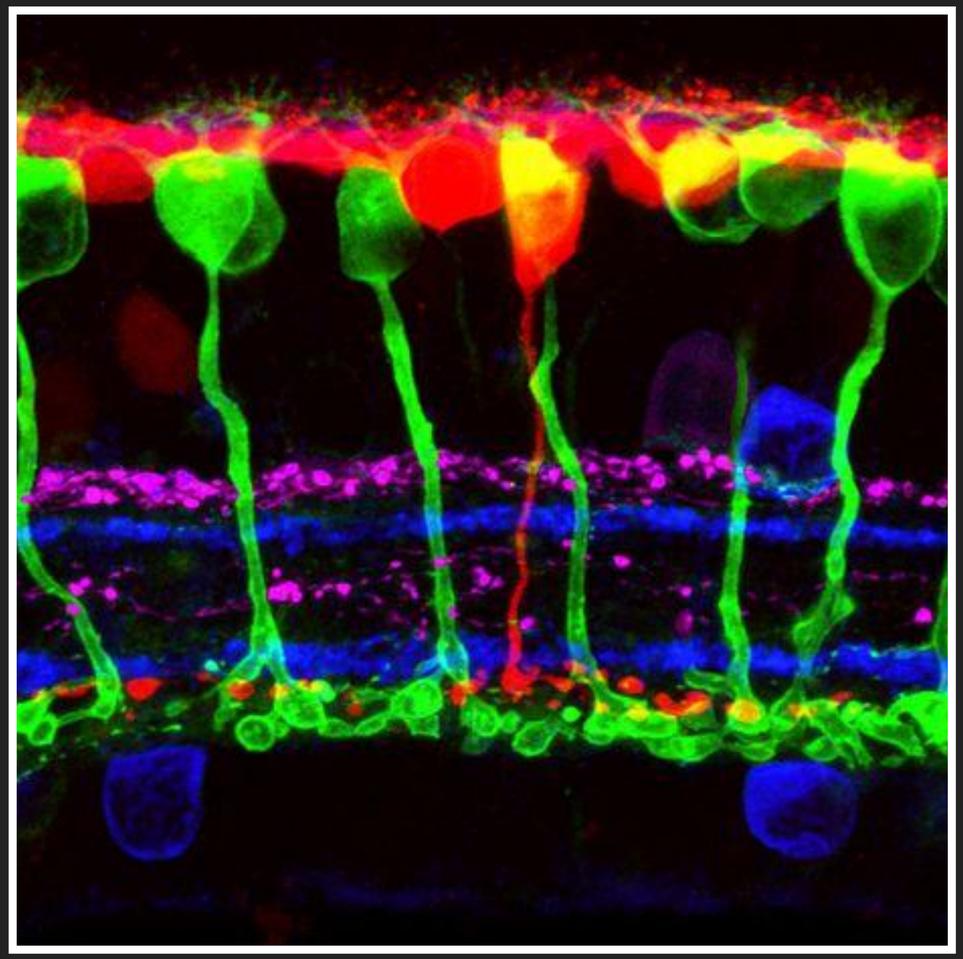


Photo by Wei Li, © National Eye Institute

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/sovitrath/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