

A close-up photograph of a white laboratory rack filled with numerous test tubes. The tubes are arranged in two rows, with some in the foreground and others receding into the background. They come in various colors, including orange, blue, purple, and yellow. Each tube has a black and white barcode label attached to its side. The lighting is bright, typical of a clinical or laboratory environment.

# Diabetic Retinopathy

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Machine Learning II Final Project

# Agenda

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- Diabetic Retinopathy Background
- Dataset
- Preprocessing
- Network Architecture
- Key Findings & Results
- Conclusion
- References

A photograph of medical equipment and supplies on a pink background. It includes a black stethoscope coiled on the left, a pair of white nitrile gloves at the top right, a green surgical mask and a pair of black-rimmed glasses resting on it, and a spiral-bound notebook with a pen lying diagonally across the bottom left.

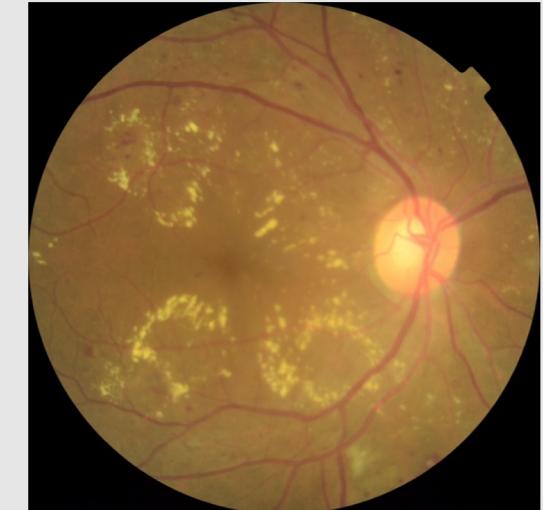
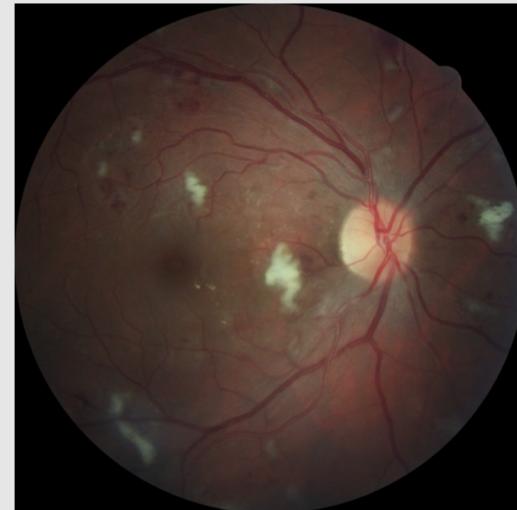
# Diabetic Retinopathy Background

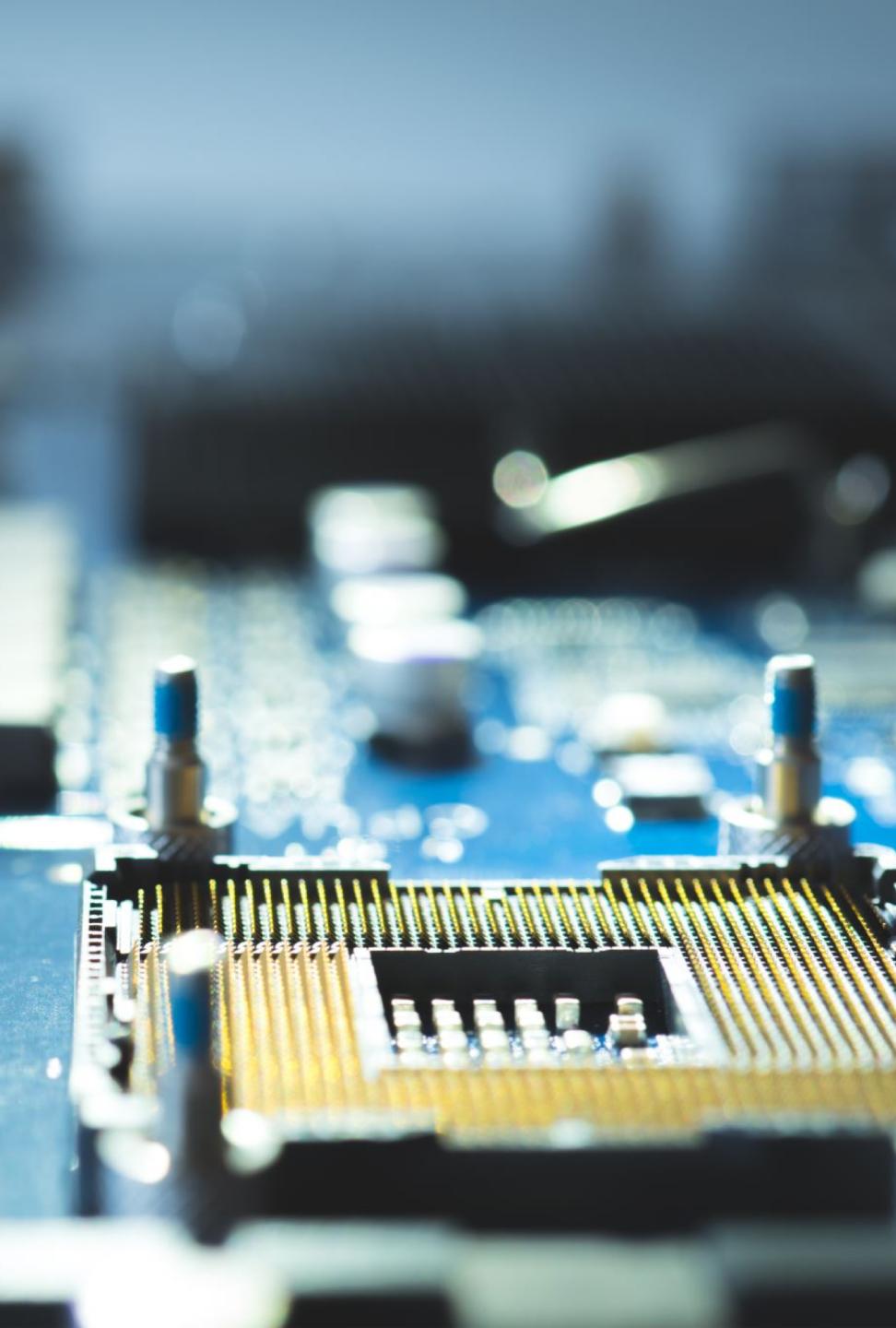
- Serious medical condition
- Leading cause of blindness
- Nearly 100 million affected by DR
- Affects 80% of those who have had diabetes for 20+ years
- Offers great value in image classification
  - Diabetic Retinopathy Detection
- Retina image scans
  - both left/right eyes of patients
  - 5 classes of varying degrees of DR

# Dataset

- 2015 Kaggle Competition Dataset
- 35,126 images with 5 classes
  - 82GB of data
  - Labels CSV
  - Derived subset
- Levels of Diabetic Retinopathy (0-4)
  - 0 – No DR
  - 1 – Mild
  - 2 – Moderate
  - 3 – Severe
  - 4 – Proliferative DR

# Example Images of Each Class (0-4)





# Preprocessing

- Create subset directory
  - 0 - 5840 (~ 74%)
  - 1 - 560 (~ 7%)
  - 2 - 1200 (~15%)
  - 3 - 160 (~ 2%)
  - 4 - 160 (~ 2%)
- Total - 7,920 images
- Read in images using cv2
  - one-hot encode labels
  - save as NumPy arrays
- Data augmentation
  - shifts, shears, flips, rotation
- Split Data
  - 80% Train
  - 20% Validation

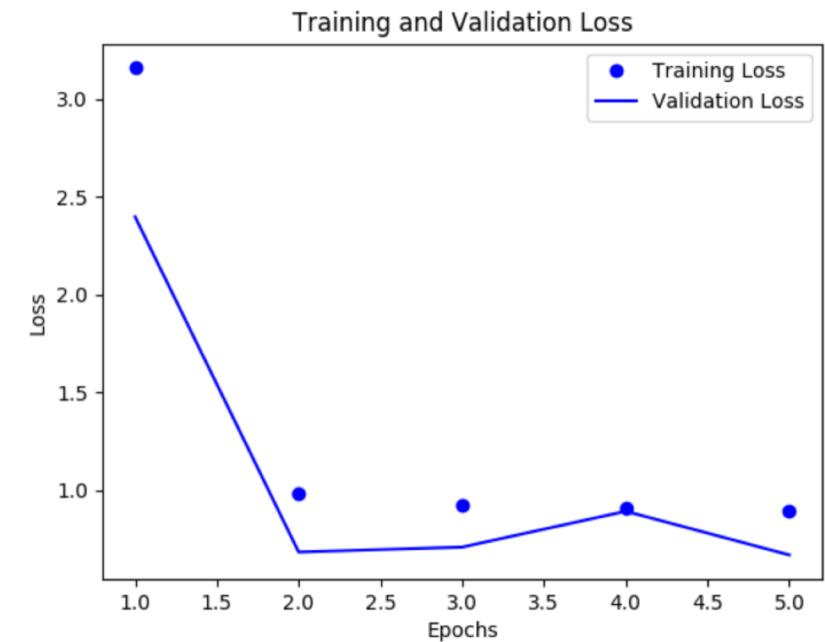
A background image featuring a complex network graph with numerous small white dots representing nodes and thin white lines representing connections, set against a gradient background that transitions from dark purple at the top to bright red at the bottom.

# Network Architecture

- Base Layer - Resnet50
  - Pre-trained Convolutional Neural Network (CNN)
  - Winner of 2015 ImageNet Challenge
  - Keras-PyCharm-GCP stack
- Top Layer - Fully Connected Layer
  - Regularization - Dropout (0.2)
- Optimizers & Activation Functions
  - Sigmoid & softmax activation
  - Adam, rmsprop, and SGD
- Freezing of layers
  - `layer.trainable=False`
  - Reduction of trainable parameters

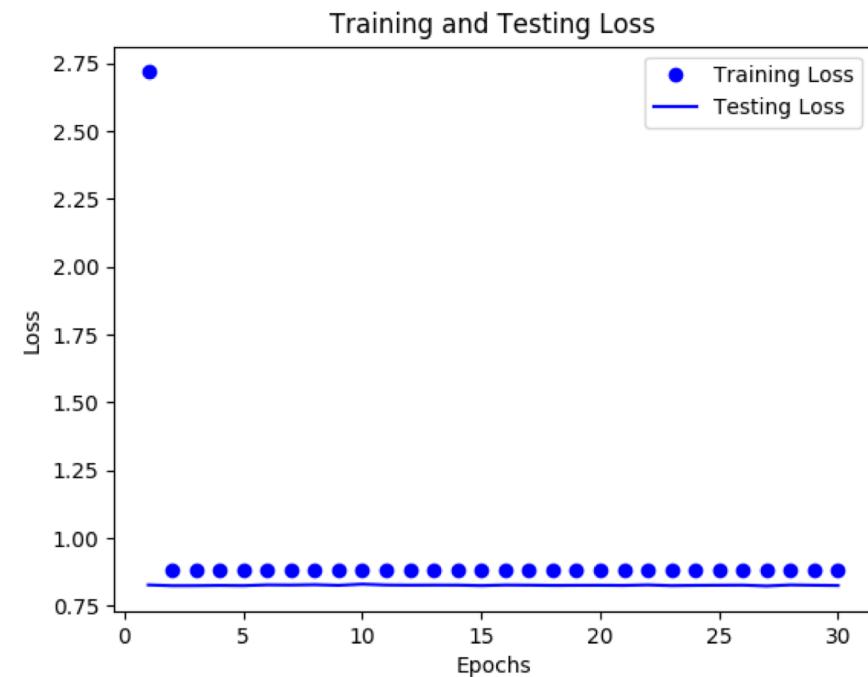
# Key Findings & Results

- Using sgd optimizer
  - 74.26% final accuracy
  - Cohen Kappa 0.0
  - f1 score 0.1812
- Using rmsprop optimizer
  - 74.31% final accuracy
  - Cohen Kappa 0.0
  - f1 score 0.1812
- Accuracy is good
  - Not able to rely only on accuracy
  - Model tends to be static even with manipulation of hyperparameters
- Using adam optimizer
  - 73.46% final accuracy
  - Cohen Kappa 0.0
  - f1 score 0.1777
- Validation accuracies
  - 82.88% for rmsprop & sgd
  - 79.95% for adam



# Key Findings & Results

- ResNet50 for 30 epochs
- Loss is constant
- 27,782,661 total parameters
  - 4,194,949 trainable when freezing
- Higher epochs does not change outcome
- Freezing had no effect on model



# Summary & Conclusion

- While accuracy is relatively high, this is not the sole indicator of a good model
  - Cohen Kappa Score of 0.0
  - No agreement between model output and validation data
- Limitations
  - Large dataset containing significant amount of noise
  - Subsetting data due to memory errors
- Future Research
  - Focus on more effective preprocessing
  - More centered data augmentation efforts
  - Investigate higher performance in terms of GPUs to train entire dataset
  - Perhaps investigate network architectures running in ensemble

# References

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- Chollet, François. (2018). Deep learning with Python. Shelter Island, NY: Manning Publications Co.
- Diabetic Retinopathy Detection (dataset). (2015). Retrieved from <https://www.kaggle.com/c/diabetic-retinopathy-detection/>.
- Dwivedi, P. (2019, January 04). Understanding and Coding a ResNet in Keras. Retrieved from <https://towardsdatascience.com/understanding-and-coding-a-resnet-in-keras-446d7ff84d33>.

# Questions

- GitHub Links:
  - <https://github.com/gcampese/FinalProject-Group7>
  - <https://github.com/nanditobandito/FinalProject-Group7>

Data Subset (hosted in GCP Bucket):

```
wget https://storage.googleapis.com/finalproject-group7-ml2/train\_subset.zip
```