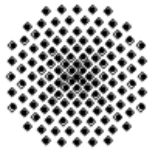

Universität Stuttgart
Institut für Signalverarbeitung und Systemtheorie
Prof. Dr.-Ing. B. Yang

Project I
Diabetic Retinopathy Detection

Deep Learning Lab
Winter-term 2020/2021

Team
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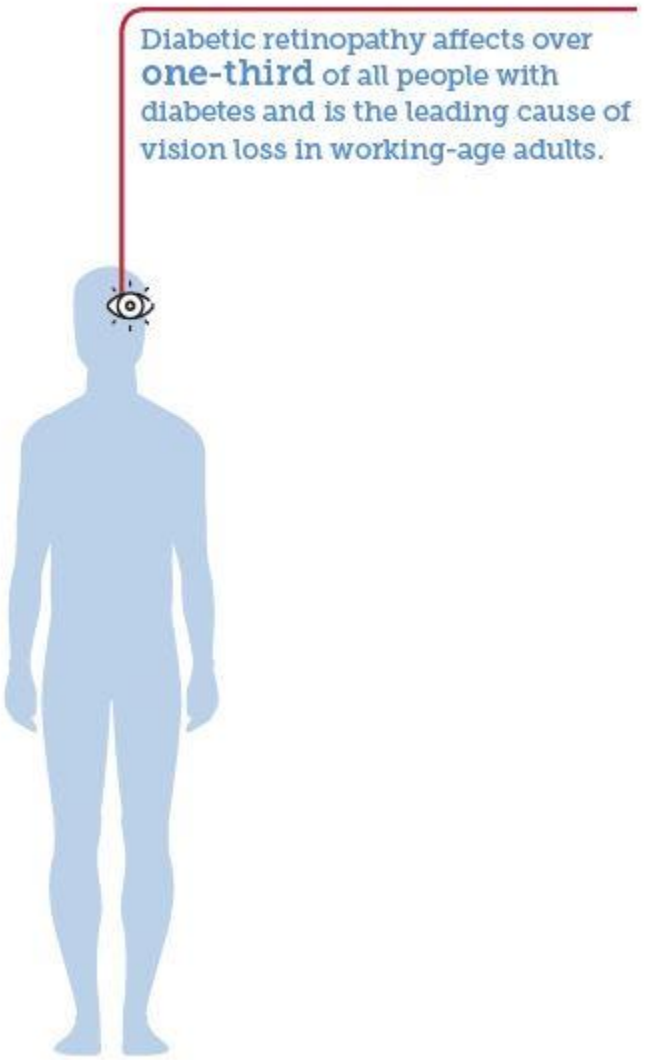
Introduction

What is Diabetic Retinopathy (DR)?

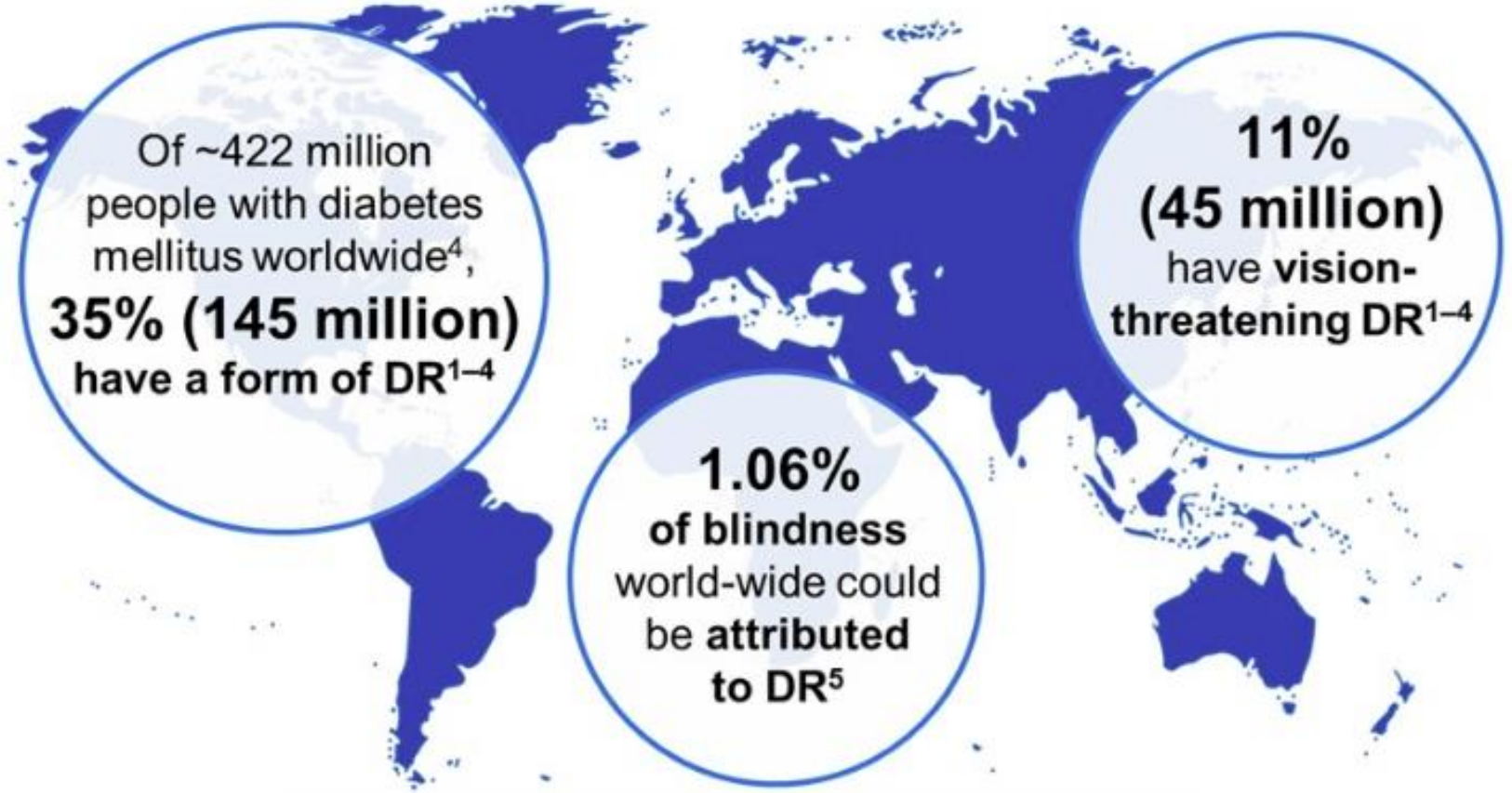
- Abnormal growth of blood vessels in the retina
- Impediment caused to the back of the eye
- Complications resulting in vision impairments
- Results in vision loss if not detected in the early stage



* *Source* https://idf.org/our-activities/care-prevention/eye-health.html

* *Please note that Diabetic Retinopathy will be addressed as DR in the presentation henceforth.*

Diabetic retinopathy (DR) is the primary cause of vision loss in adults aged 20–74 years[1–3]



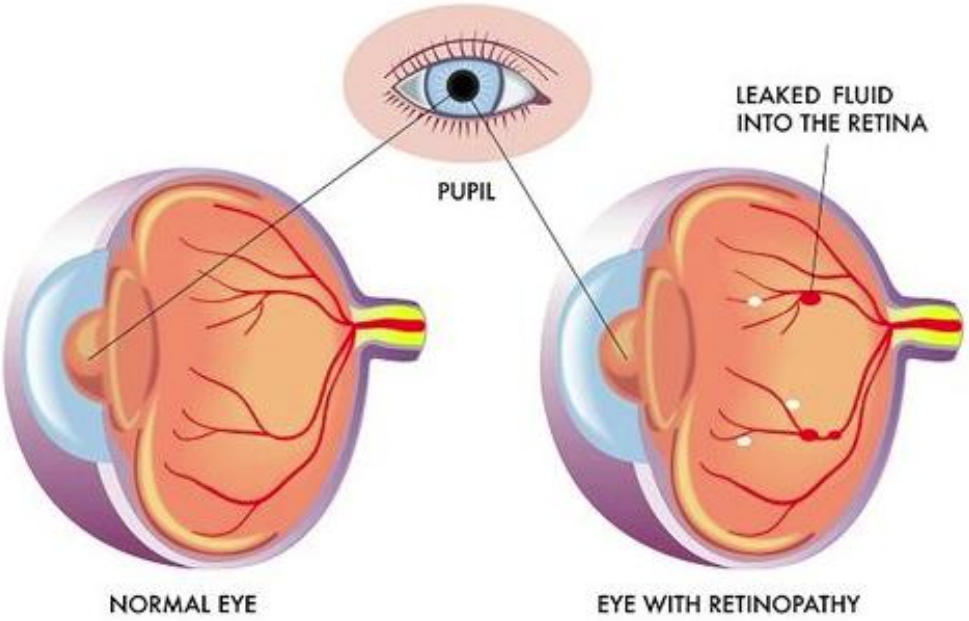
…these numbers are estimated to rise, as the prevalence of diabetes increases[1,3–5]

DR, diabetic retinopathy

1. Lee R, et al. Eye Vis (Lond). 2015;2:17; 2. Ting DSW, et al. Clin Exp Ophthalmol. 2016;44:260–77; 3. Yau JWY, et al. Diabetes Care. 2012;35:556–564;
4. IAPB Vision Atlas. Diabetic Retinopathy. http://atlas.iapb.org/vision-trends/diabetic-retinopathy/ [last accessed March 2018];
5. Flaxman SR, et al. Lancet Glob Health. 2017;5:e1221–34

Motivation

- Detect the changes between the healthy and unhealthy retina
- Overcome the need of a trained opthamologist
- Overcome the complications of DR



Complications of DR

- Vitreous hemorrhage
- Retinal detachment
- Glaucoma
- Blindness

Objective

Build a Deep learning model for DR Image Classification

Facilitate the DR Screening Process

Creating an aid for medical diagnostics in the field of DR

System Flow

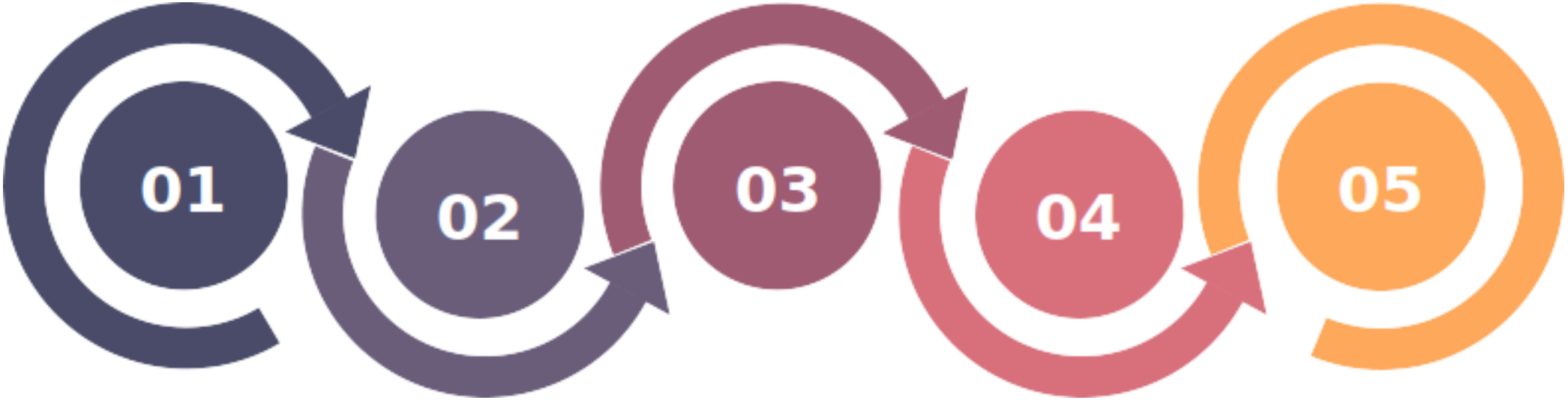
1. Data Preprocessing – Input Pipeline

2. Model Architecture

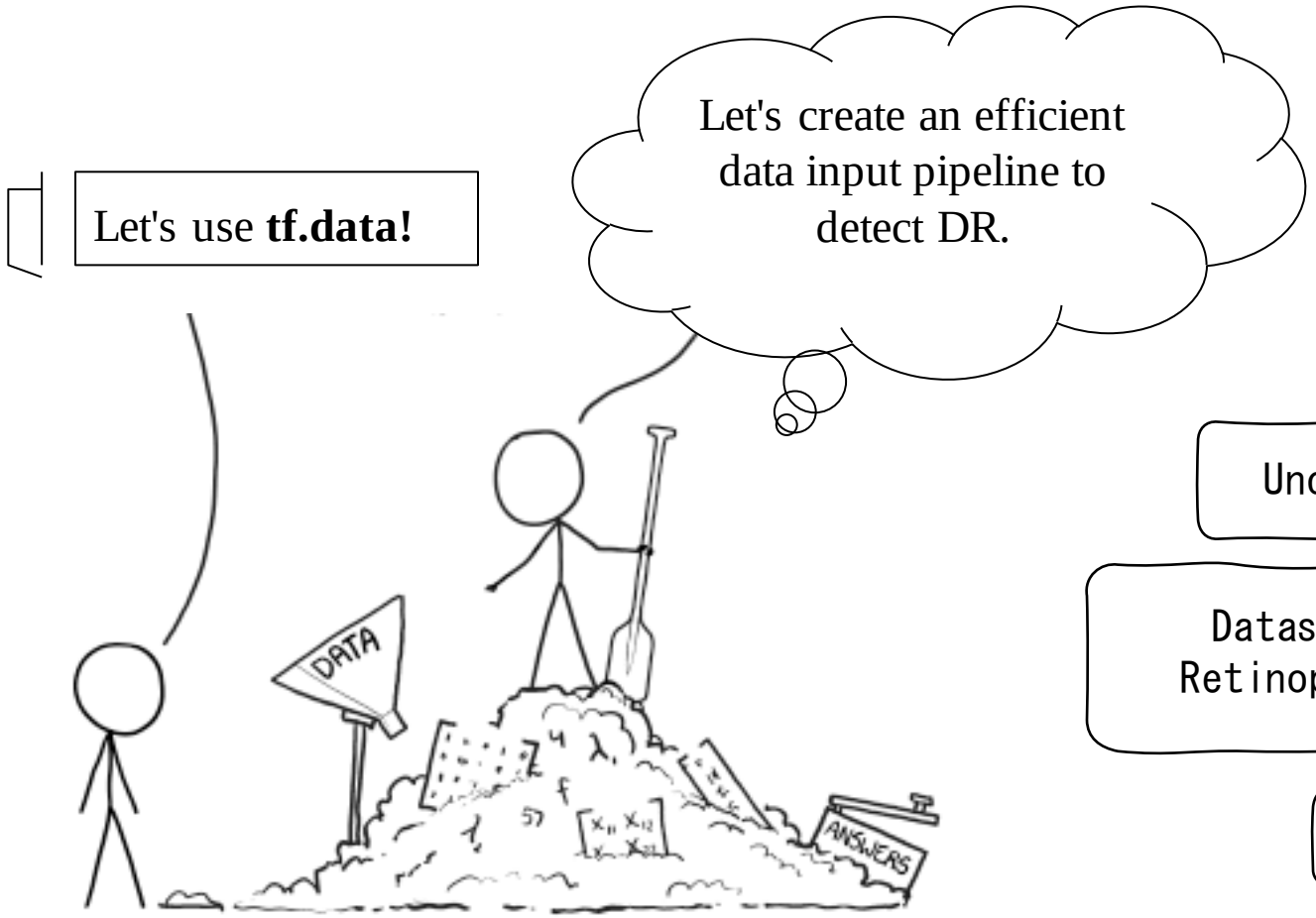
3. Model Training

4. Evaluation and Metrics

5. Deep Visualization



Data Preprocessing - Input Pipeline



Understanding the data

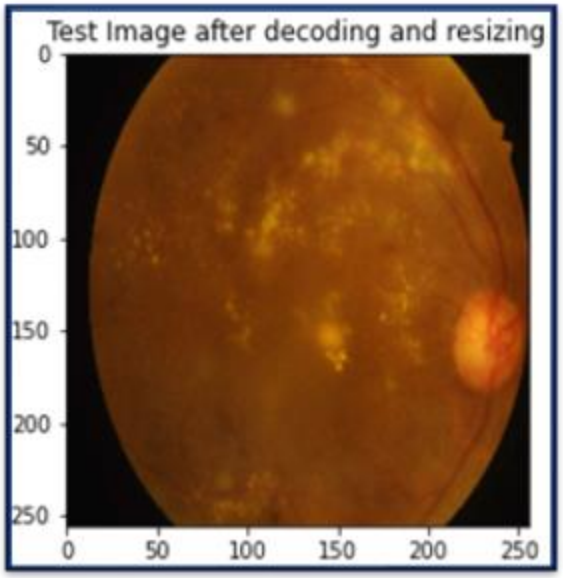
Dataset Used : Indian Diabetic Retinopathy Image Dataset (IDRID)

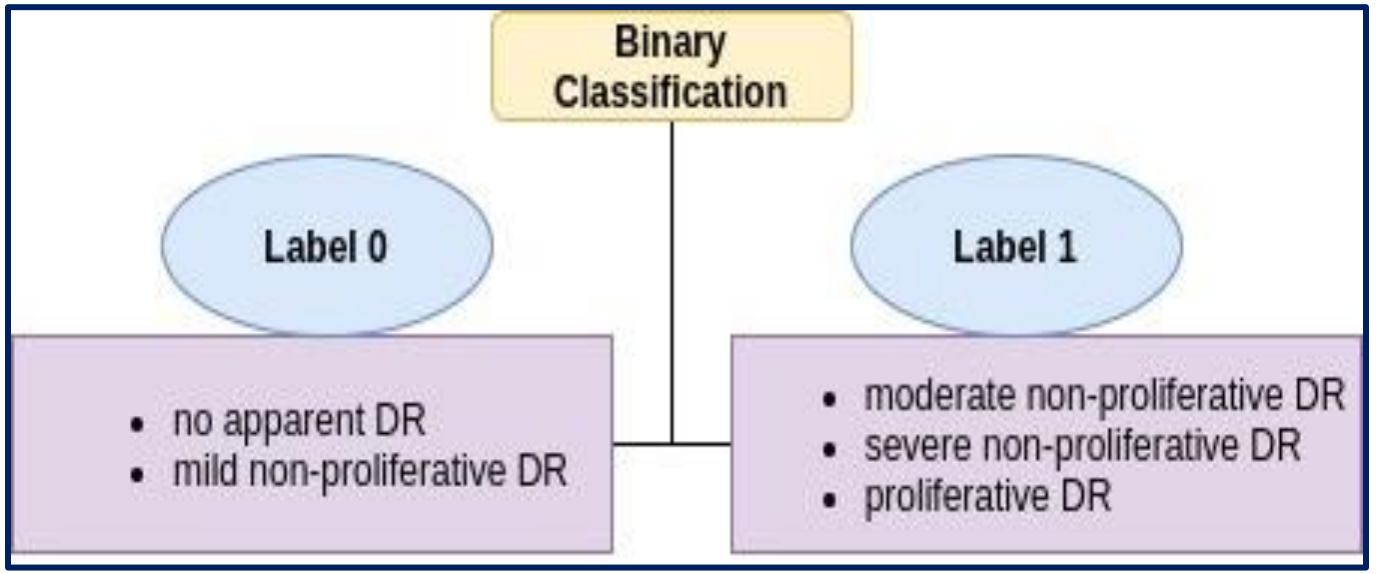
Image resizing

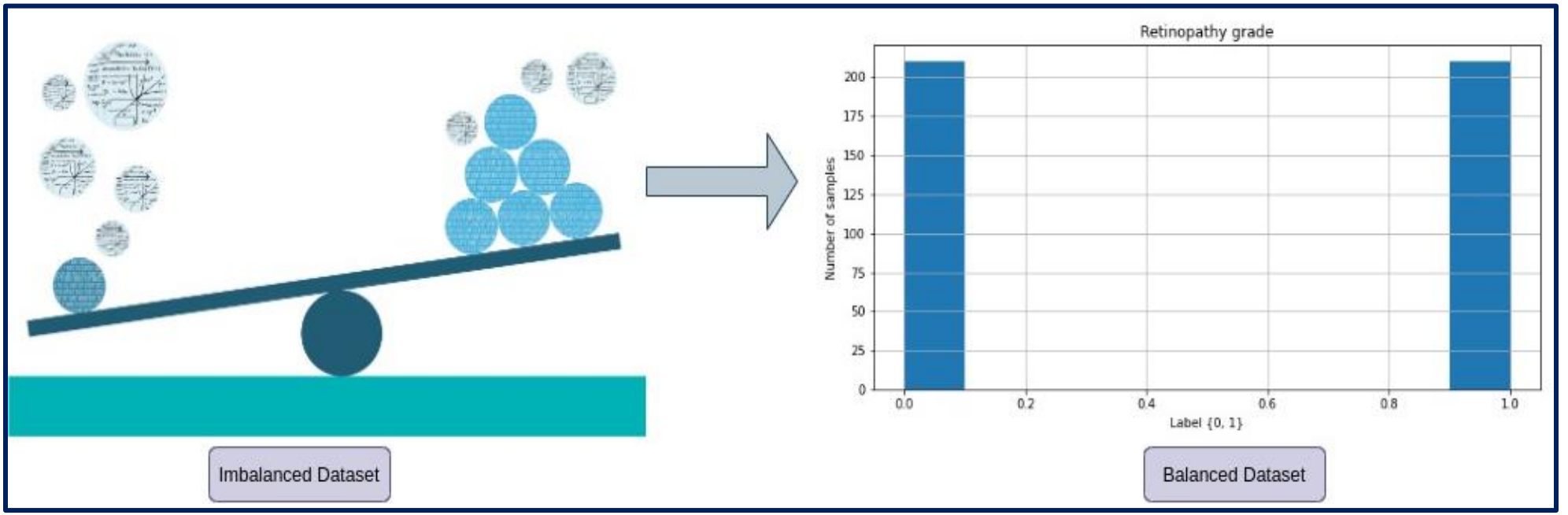
Binary Classification

Balancing the dataset - Random Oversampling

Data Preprocessing - Input Pipeline







Input Pipeline Creation

516 - Fundus Images

413 – Train Images

103 – Test Images

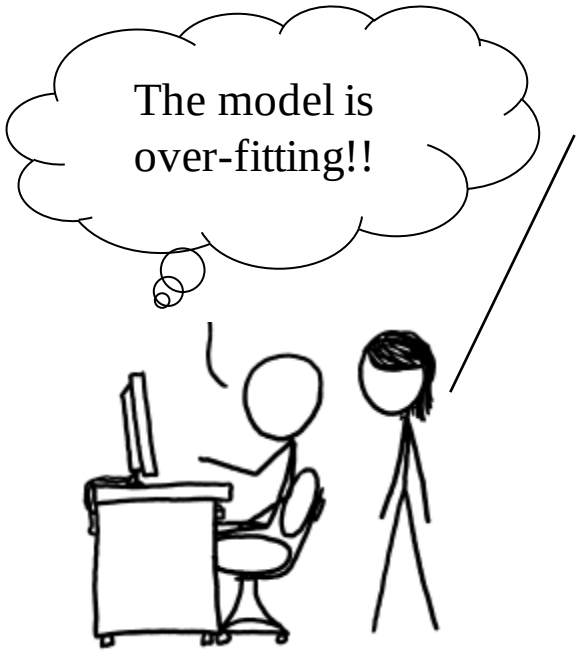
Input image size – 256 x 256

Model with overfitting

Configuring dataset for performance

To train a model precisely, the following are to be taken care of,

- Shuffling
- Batching



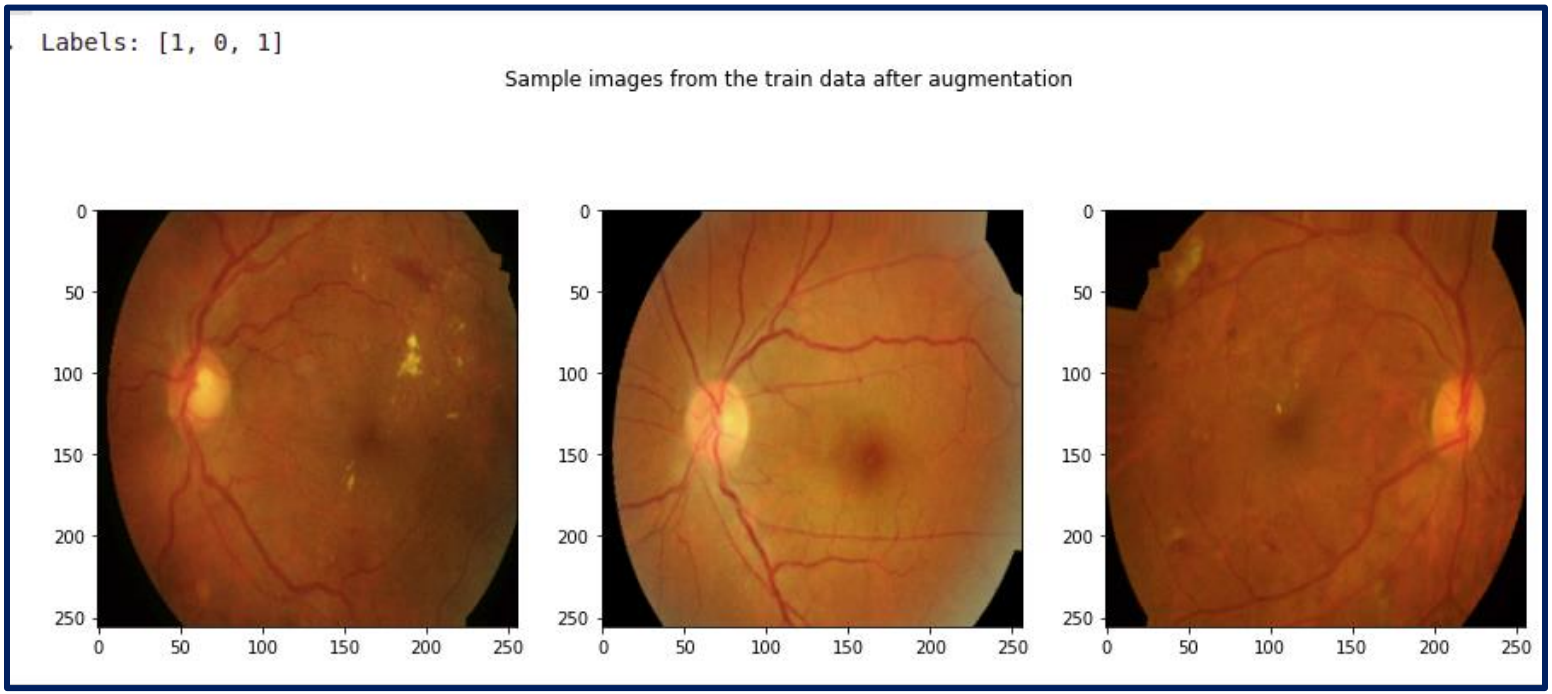
Well! We can try augmenting the images. Also take a note of the dropout layer too!

Reducing Overfitting

1. Data Augmentation

Operations Performed

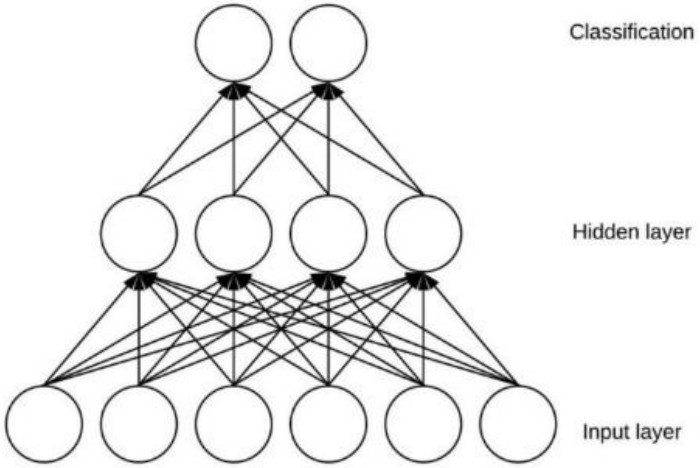
- Rotation
- Zoom
- Shift
- Horizontal and Vertical Flipping



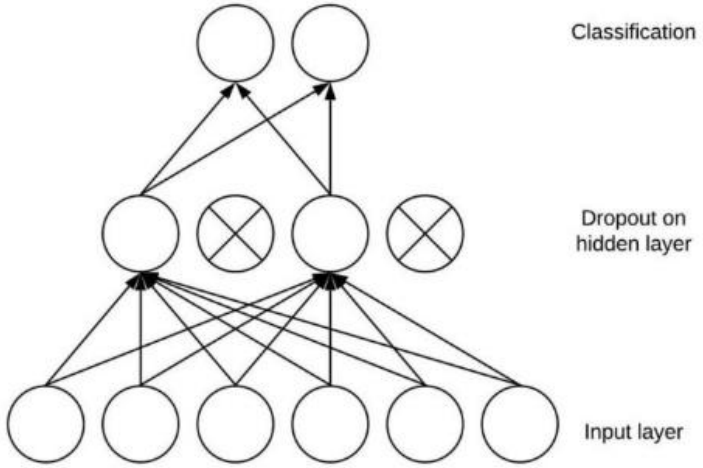
Reducing Overfitting

2. Adding Dropout Layers

Input of Dropout Layer	Fractional Number (0.1, 0.2, 0.3,…..)
Action Performed	Drops 10%, 20%, 30%, …. of the output units randomly from the applied layer.

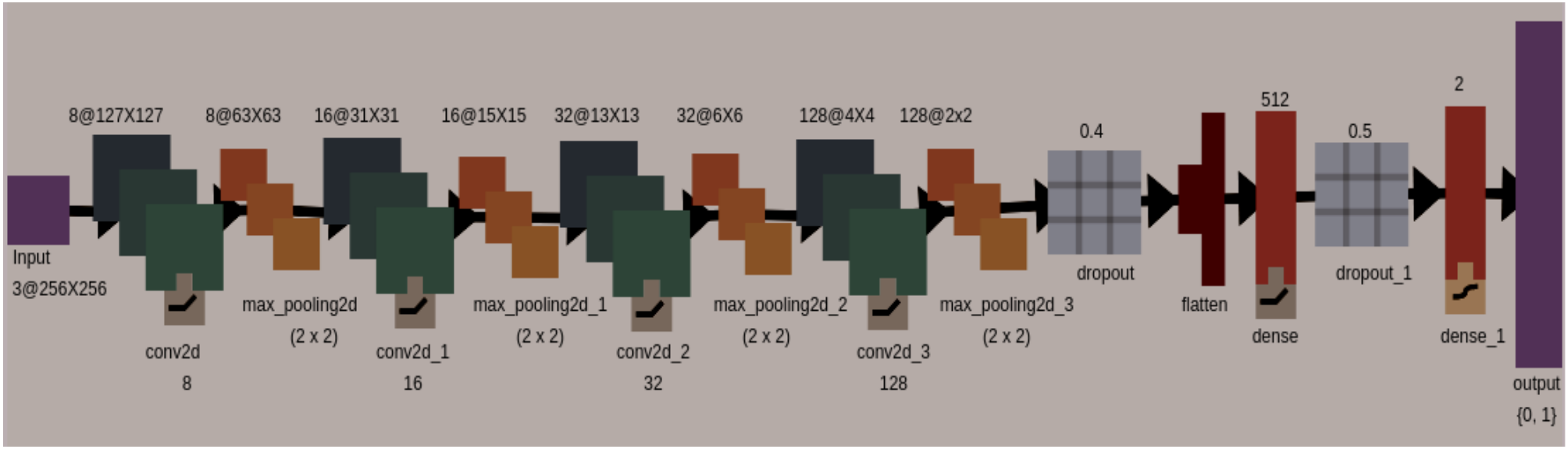


Without Dropout



With Dropout

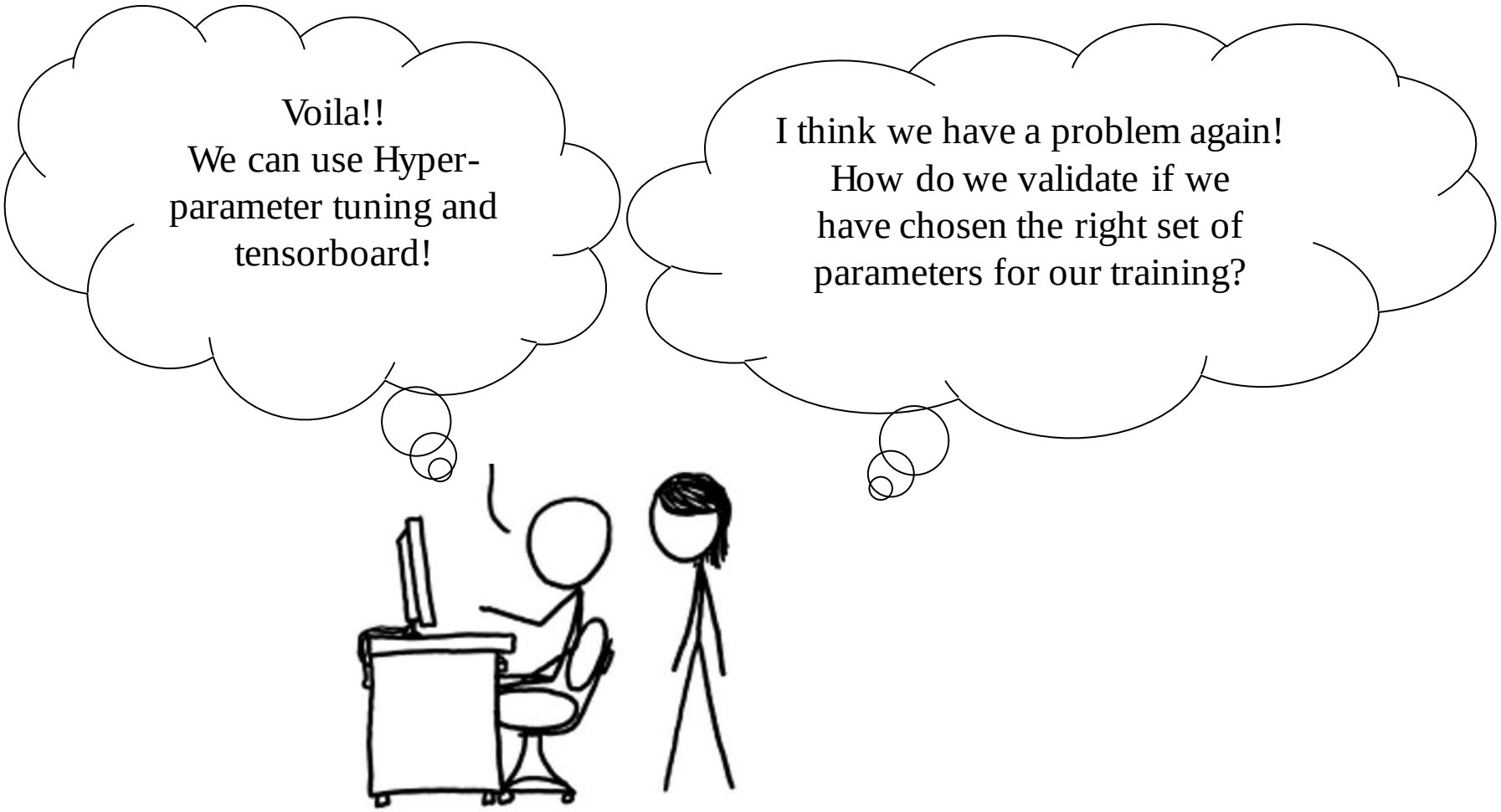
Model Architecture



The model consists of ,

- **Convolutional Neural Network(CNN)**
- **Max-Pooling Layer**
- **Dropout**

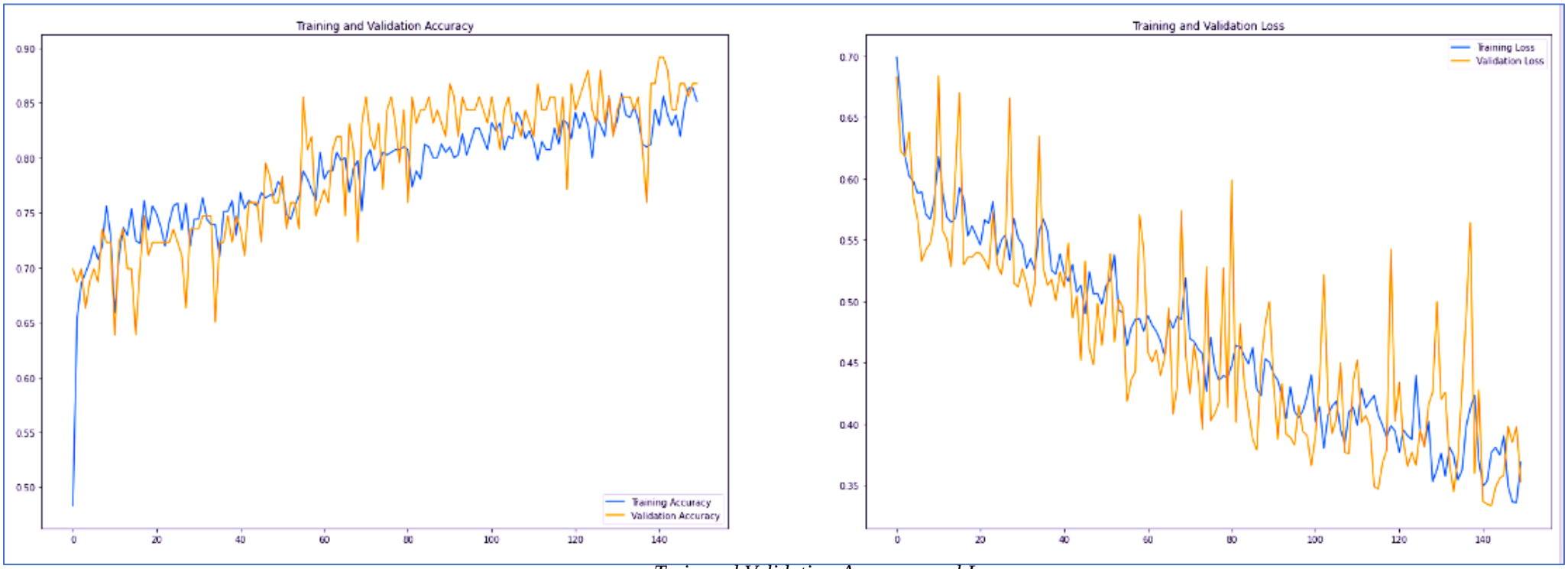
Training and Evaluation



Training and Evaluation

Hyperparameter Tuning (HPT)

	Selection based on HPT
• HP_OPTIMIZER	Optimizer - Adam
• HP_EPOCHS	Number of Epochs - 150
• HP_DENSE_LAYER	Dense layer - 512
• HP_DROPOUT	Dropout - 0.4, 0.5



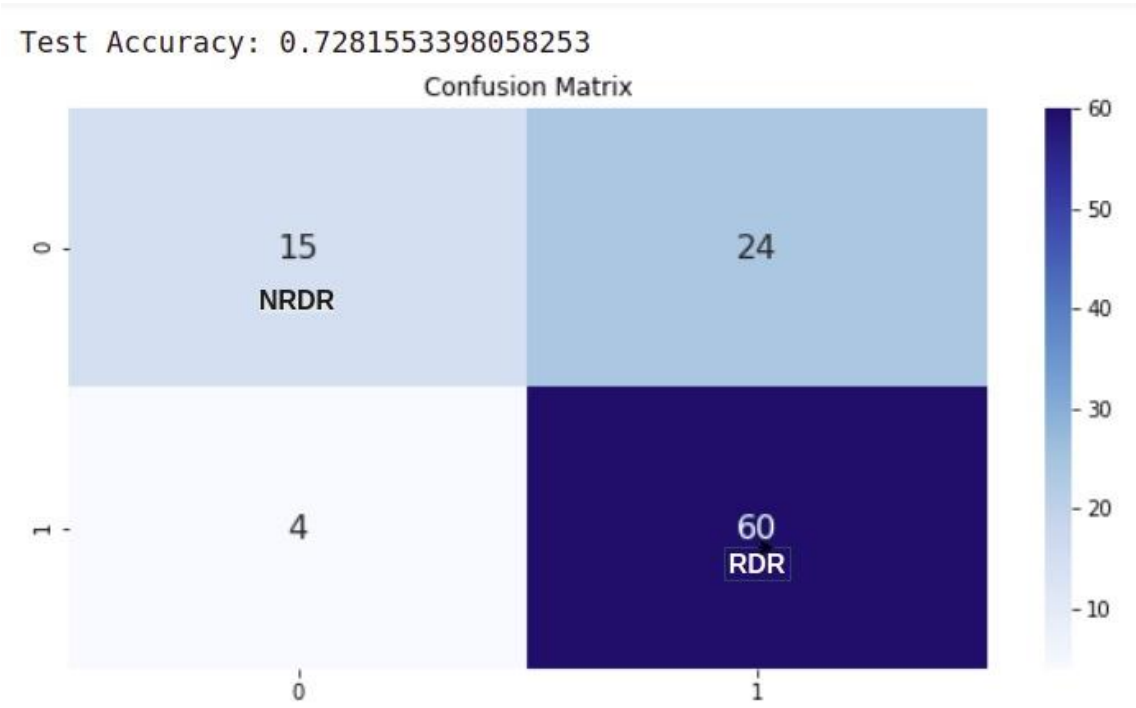
Train and Validation Accuracy and Loss

Training and Evaluation

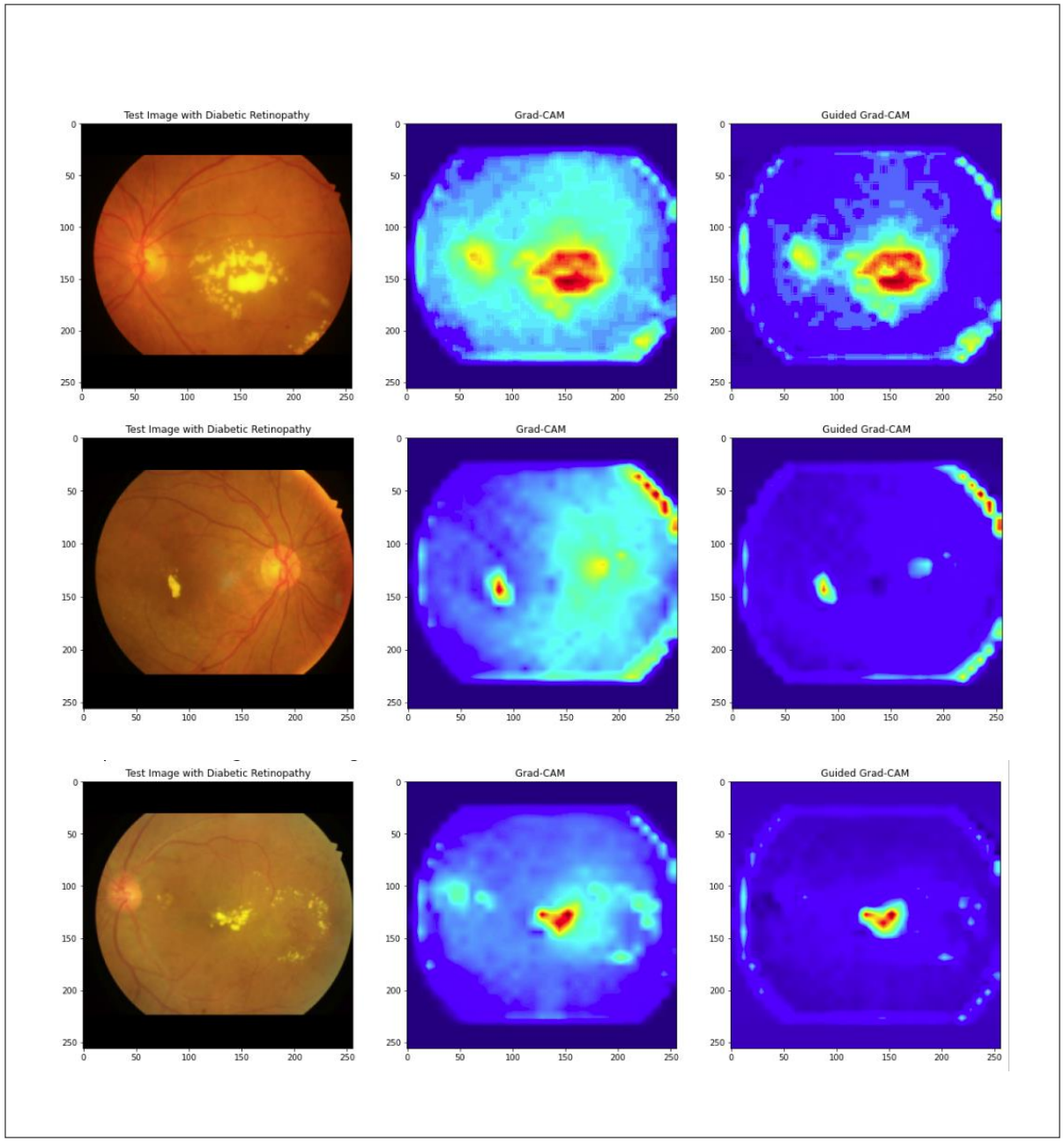
Metrics

Confusion Matrix : Describes the performance of the model
The final achieved test accuracy is about **72.81%.**

		Predicted class: P	Predicted class: N
Actual Class	P	True Positives (TP)	False Negatives (FN)
	N	False Positives (FP)	True Negatives (TN)



Deep Visualization



Grad-CAM

- Localizes image regions with relevance
- Visualizes gradients of the final conv2D layer

Grad-CAM + Guided Backpropagation

- Nullifies the gradients associated with negative value

Conclusion and Future Scope

- Model for early detection of patients with the highest risk of vision loss.
- Timely referral to a retinal specialist
- Aims at preventing irreversible vision impairments.
- Feasible deployment across different eye-care centers

Future Scope:

- Diabetics can be classified as , Type1 – Juvenile and Type 2 – Elderly Individuals
- Dataset can be collected and analysed based on the,
- Age I Type of Diabetics
- Drug used – Insulin and Oral

References

[1] https://www.tensorflow.org/tutorials/load_data/images

[2] Selvaraju, Ramprasaath R. ; Cogswell, Michael ; Das, Abhishek ; Vedantam, Ramakrishna ; Parikh, Devi ; Batra, Dhruv: Grad-cam: Visual explanations from deep networks via gradient-based localization. In: Proceeding Conference on Computer Vision, 2017, S. 618–626

[3] https://math.mit.edu/ennui/

[4] Deep Learning Course and Lab lectures and slides

Thank you