

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

# Project I

# Diabetic Retinopathy Detection

Deep Learning Lab  
Winter-term 2020/2021

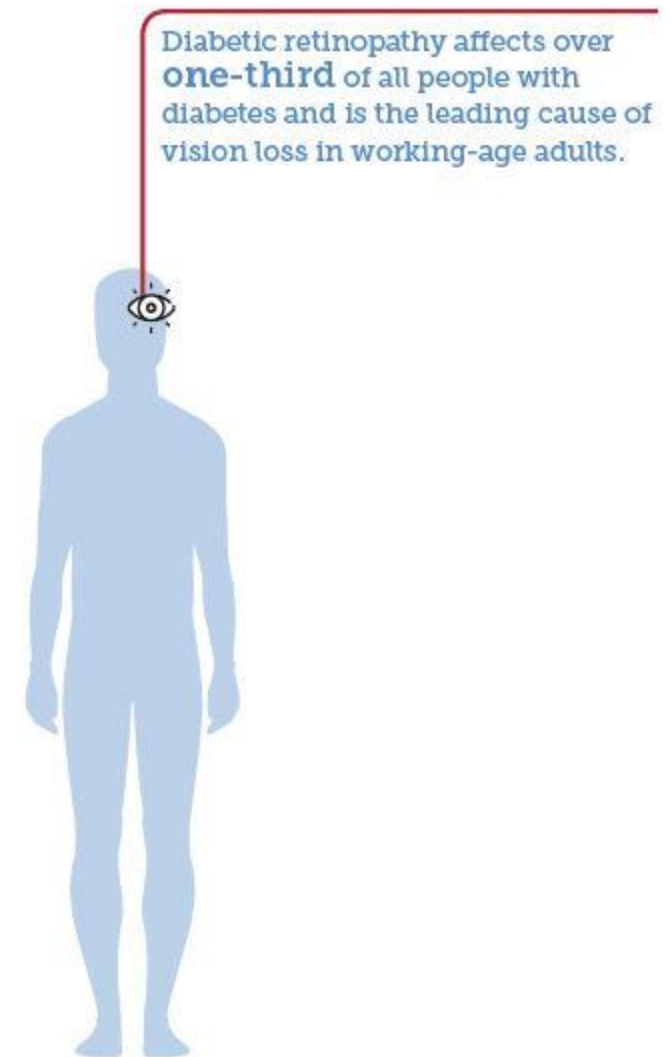
Team

Ram Sabarish Obla Amar Bapu (st169693)

Swetha Lakshmana Murthy (st169481)

## What is Diabetic Retinopathy (DR)?

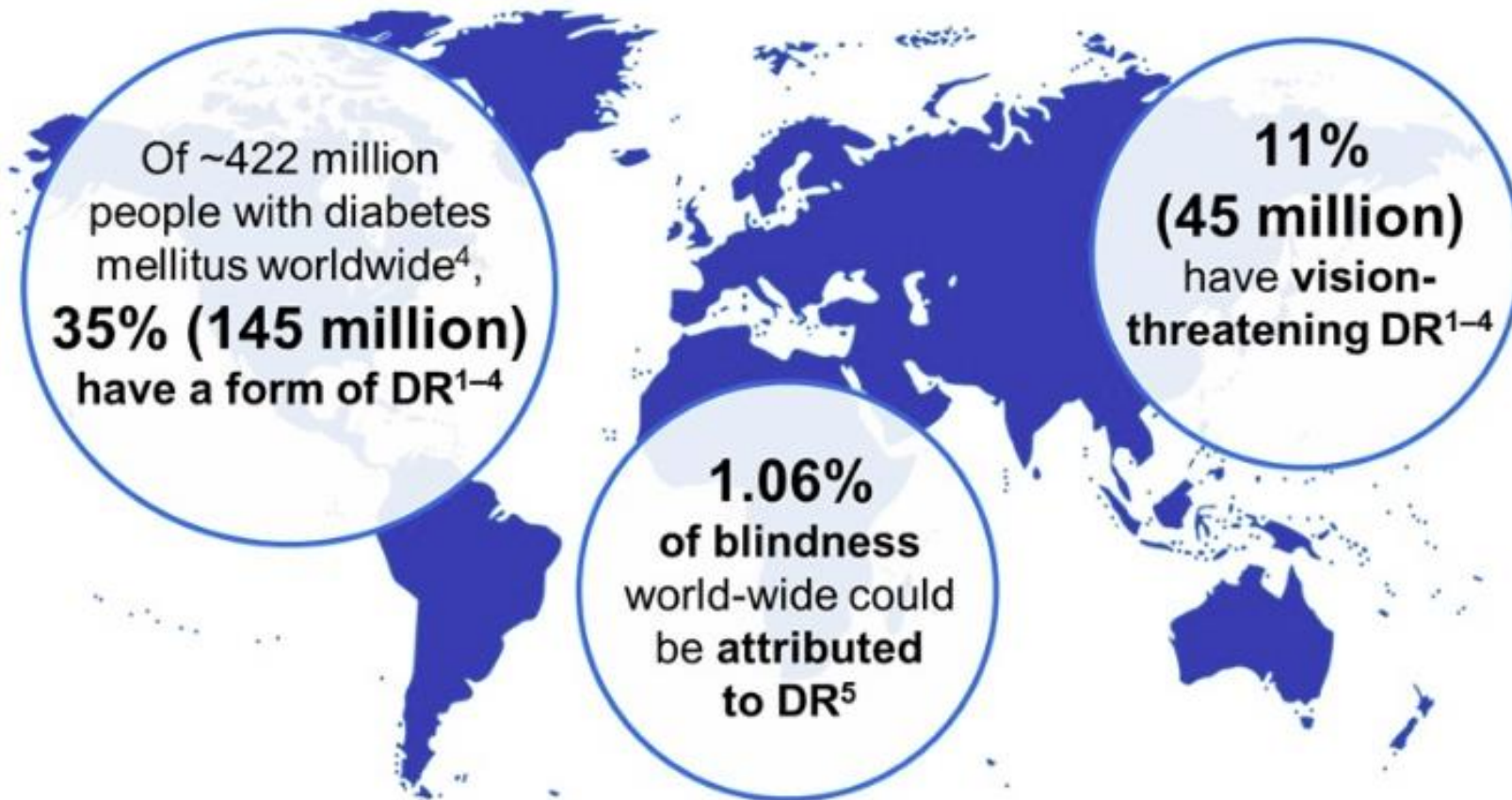
- Abnormal growth of blood vessels in the retina
- Impediment caused to the back of the eye
- Complications resulting in vision impairments
- Results in vision loss if not detected in the early stage



\* 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<sup>1–3</sup>



...these numbers are estimated to rise, as the prevalence of diabetes increases<sup>1,3–5</sup>

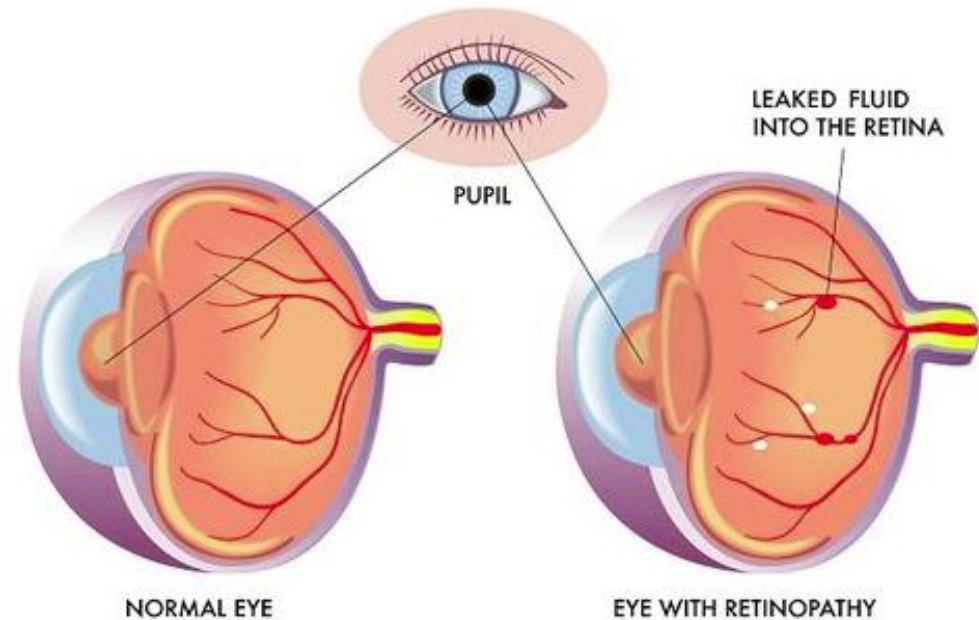
DR, diabetic retinopathy

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

**Build a Deep learning  
model for DR Image  
Classification**



**Facilitate the DR  
Screening Process**

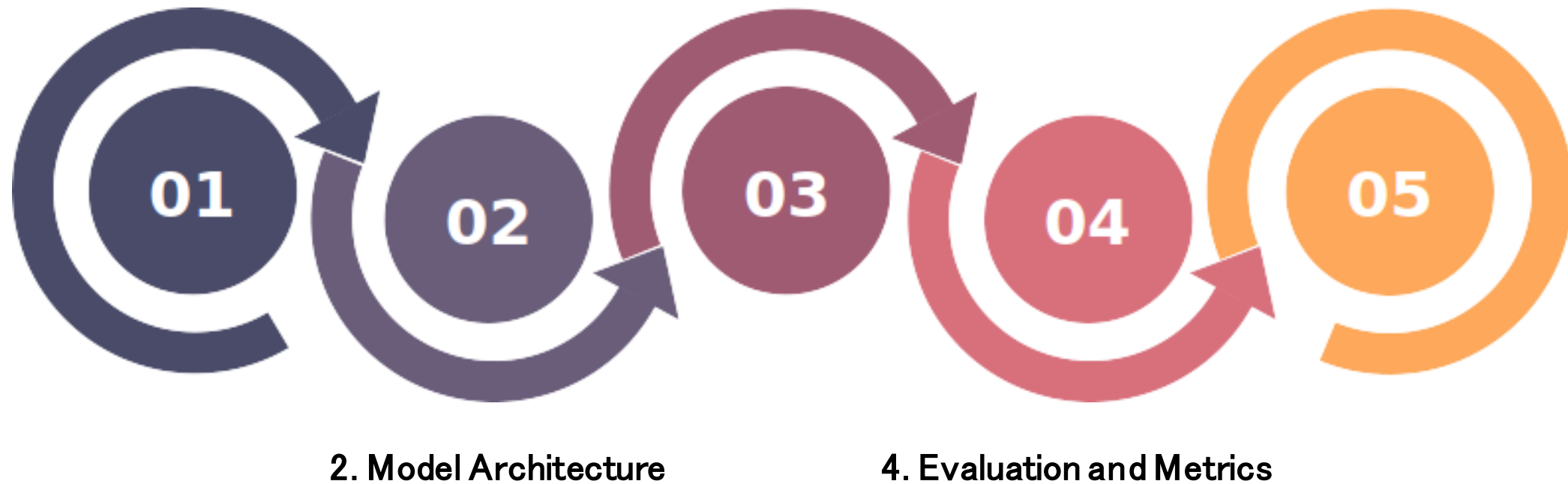
**Creating an aid for  
medical diagnostics  
in the field of DR**



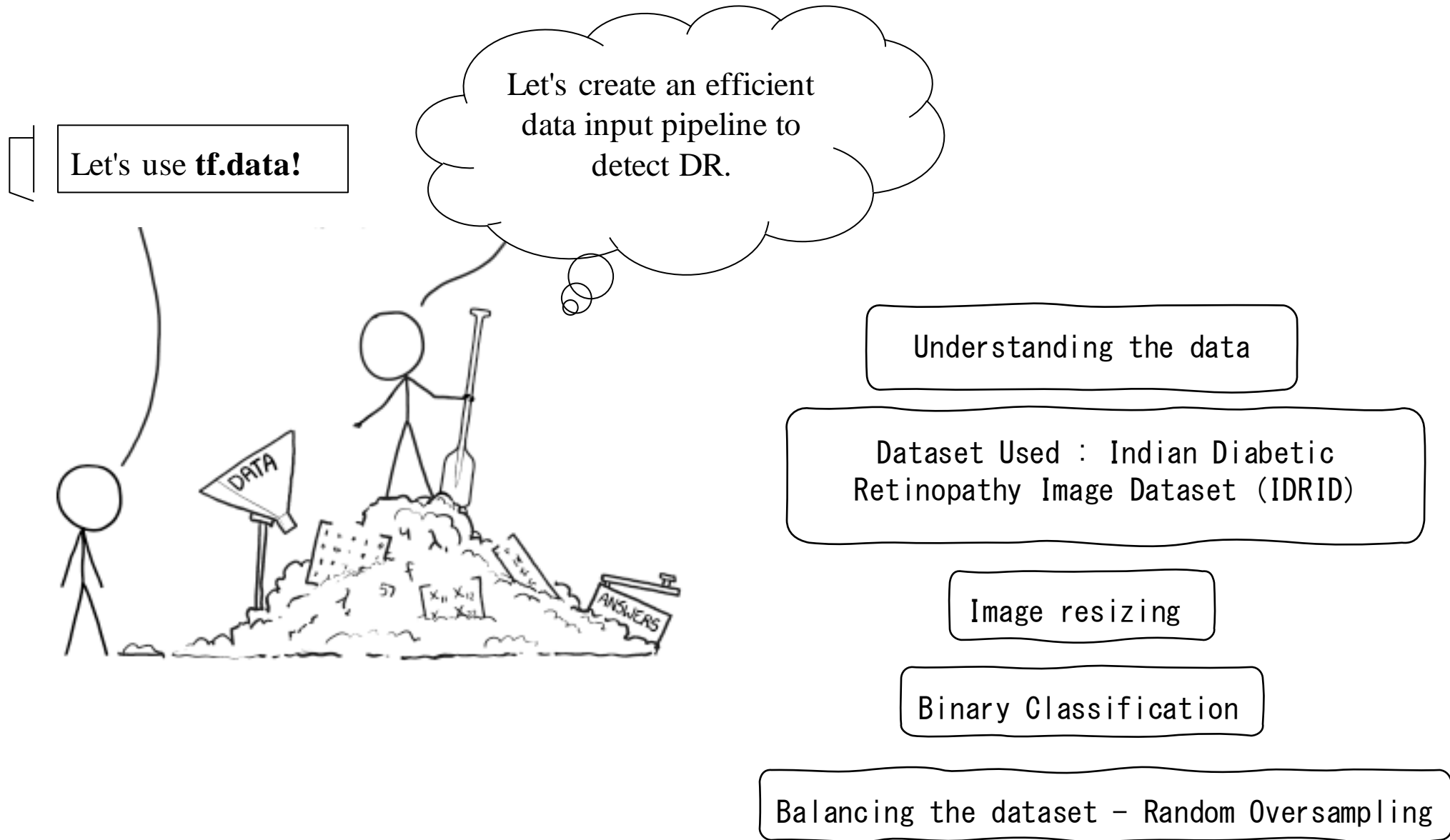
1. Data Preprocessing –  
Input Pipeline

3. Model Training

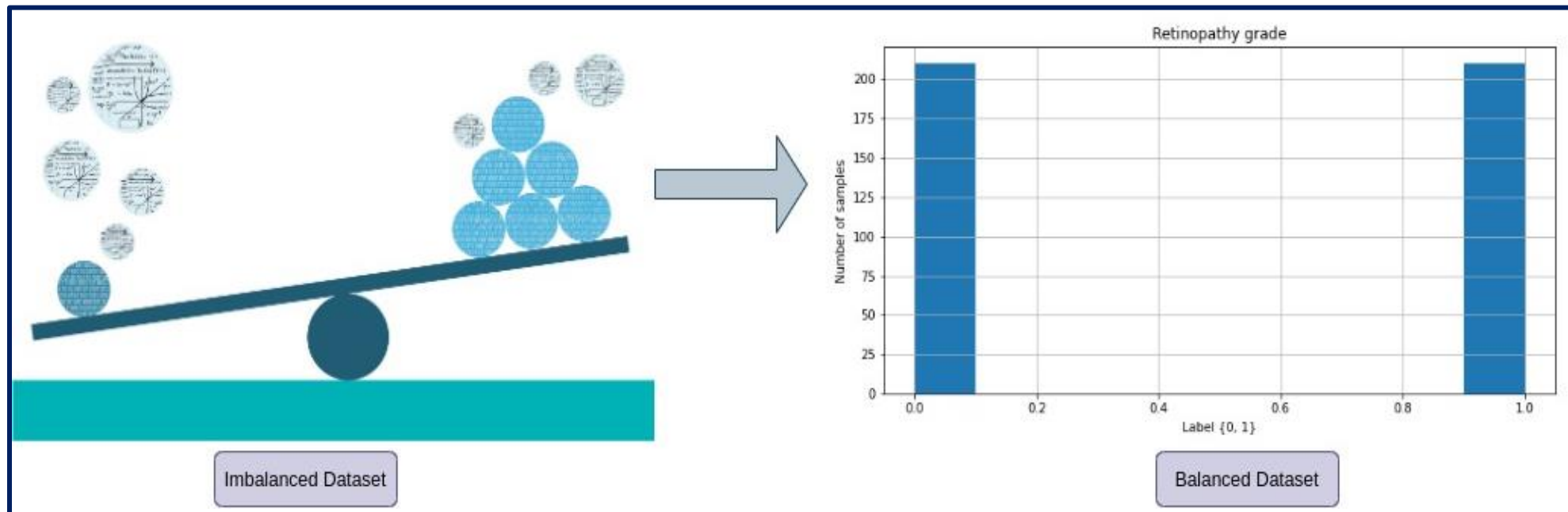
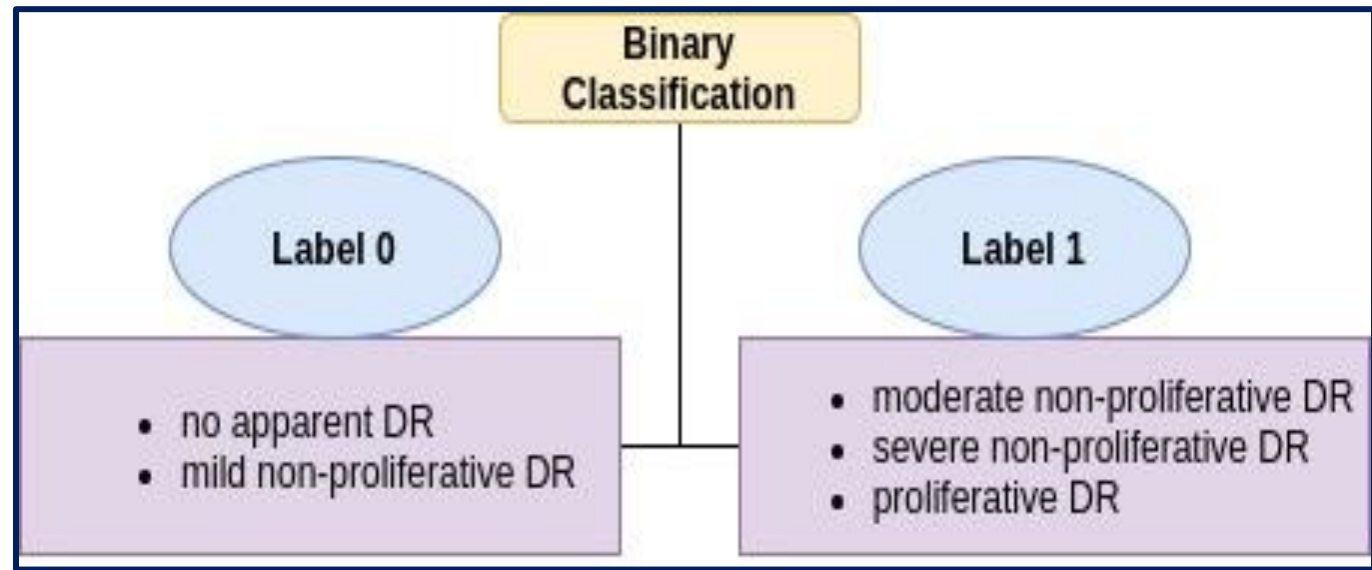
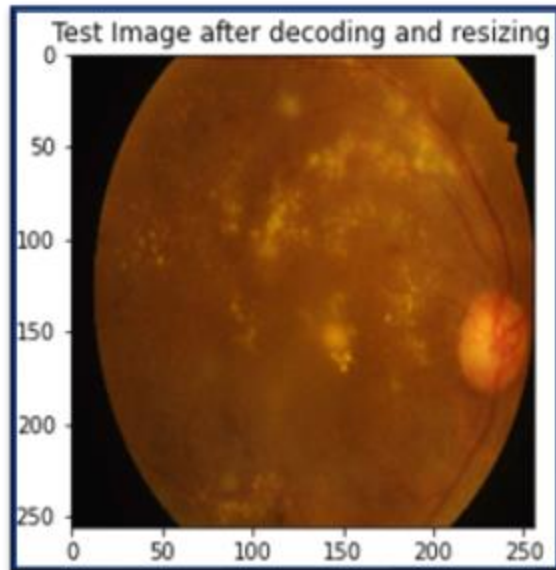
5. Deep Visualization



# Data Preprocessing - Input Pipeline



# Data Preprocessing - Input Pipeline





# Input Pipeline Creation



**516 - Fundus Images**

**413 – Train Images**

**103 – Test Images**

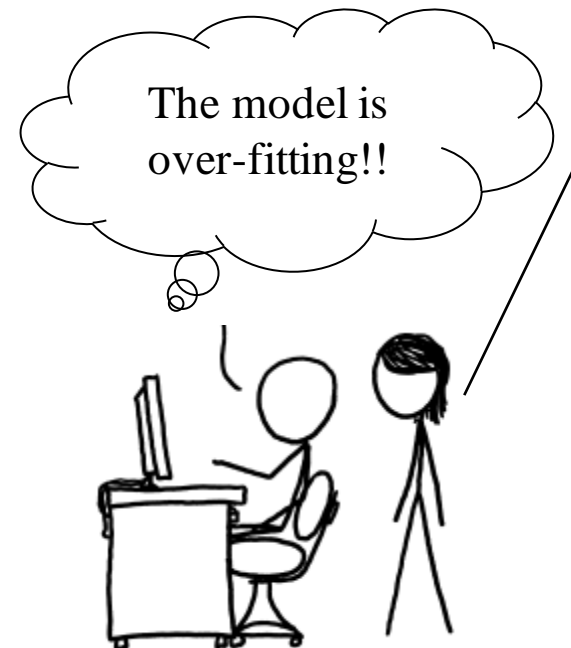
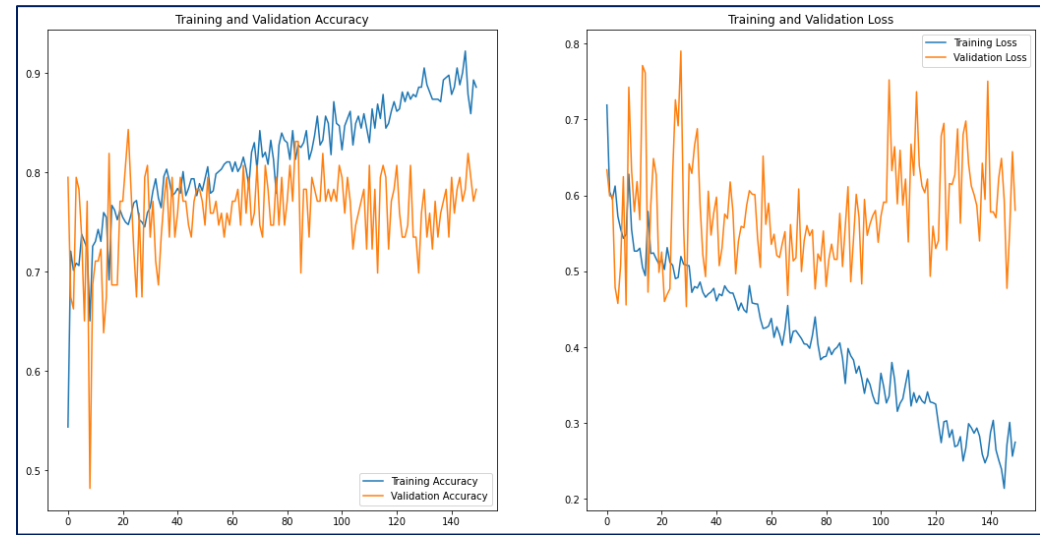
**Input image size – 256 x 256**

## Configuring dataset for performance

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

- Shuffling
- Batching

*Model with overfitting*

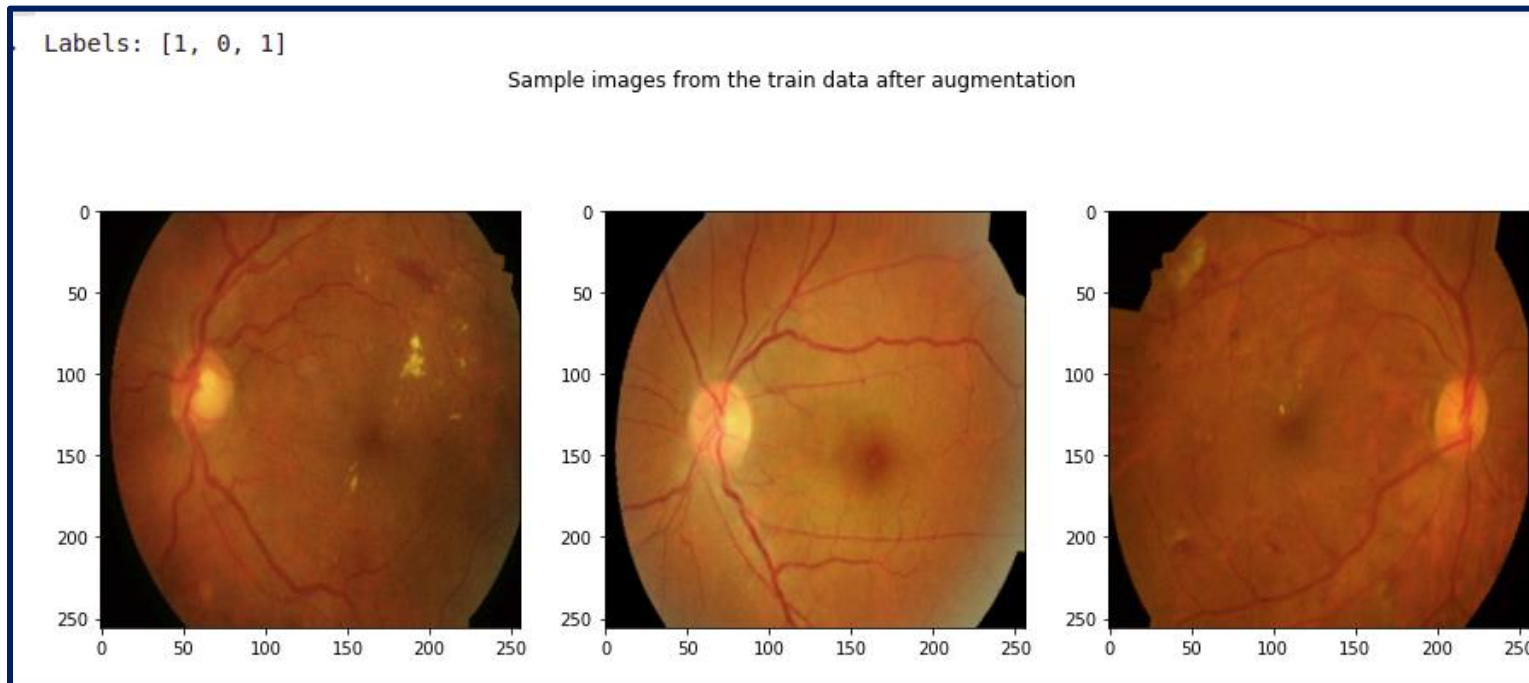


Well! We can try augmenting the images. Also take a note of the dropout layer too!

## 1. Data Augmentation

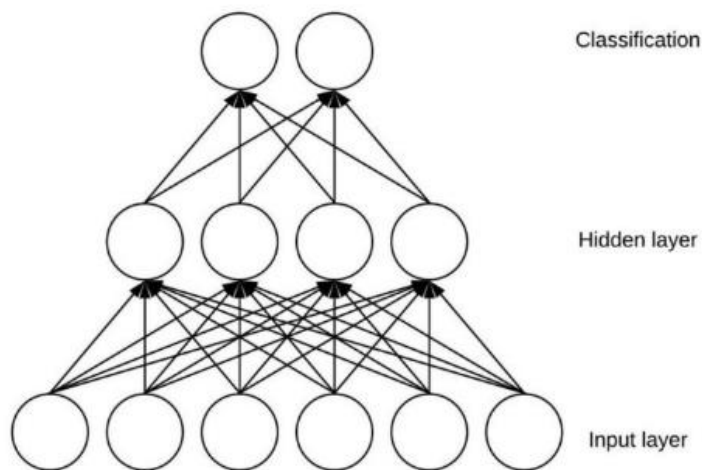
### Operations Performed

- Rotation
- Zoom
- Shift
- Horizontal and Vertical Flipping

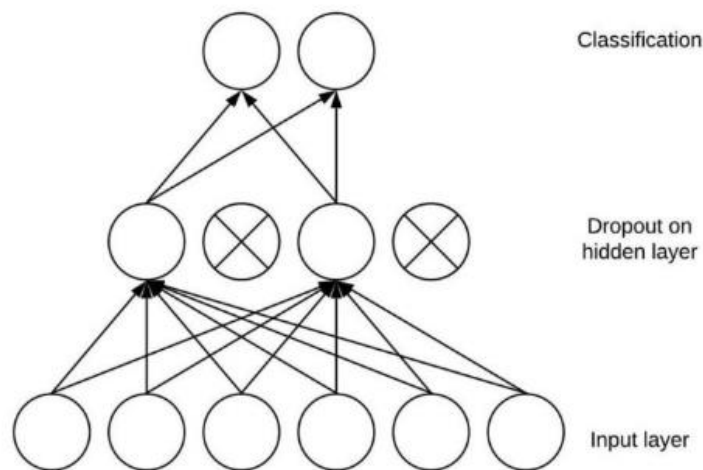


## 2. Adding Dropout Layers

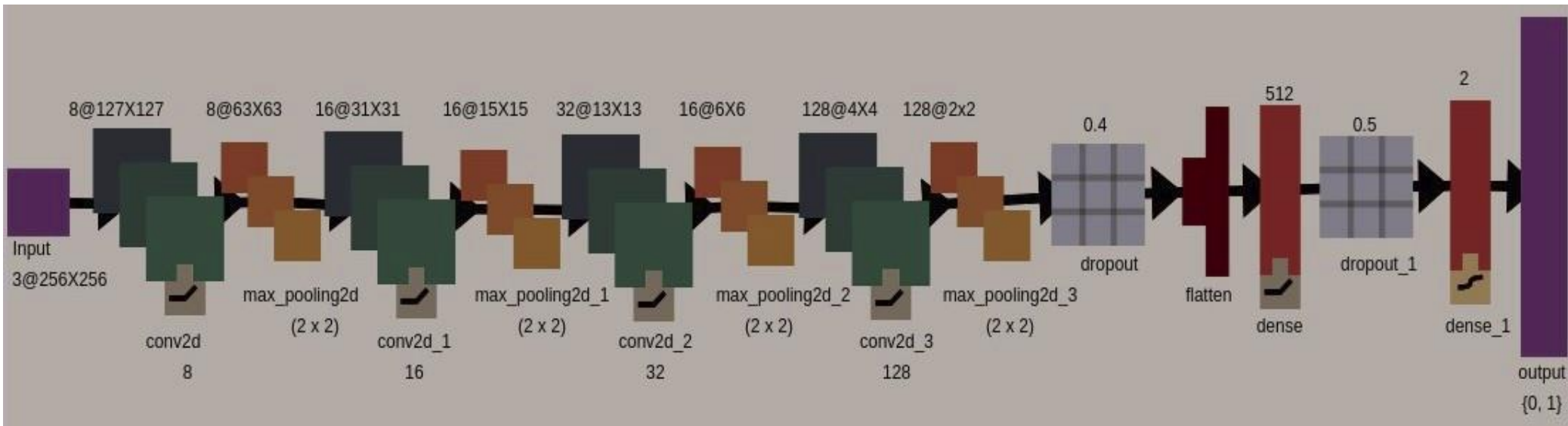
Input of Dropout Layer	Fractional Number (0.1, 0.2, 0.3,.....)
Action Performed	Drops 10%, 20%, 30%, .... of the output units randomly from the applied layer.



**Without Dropout**

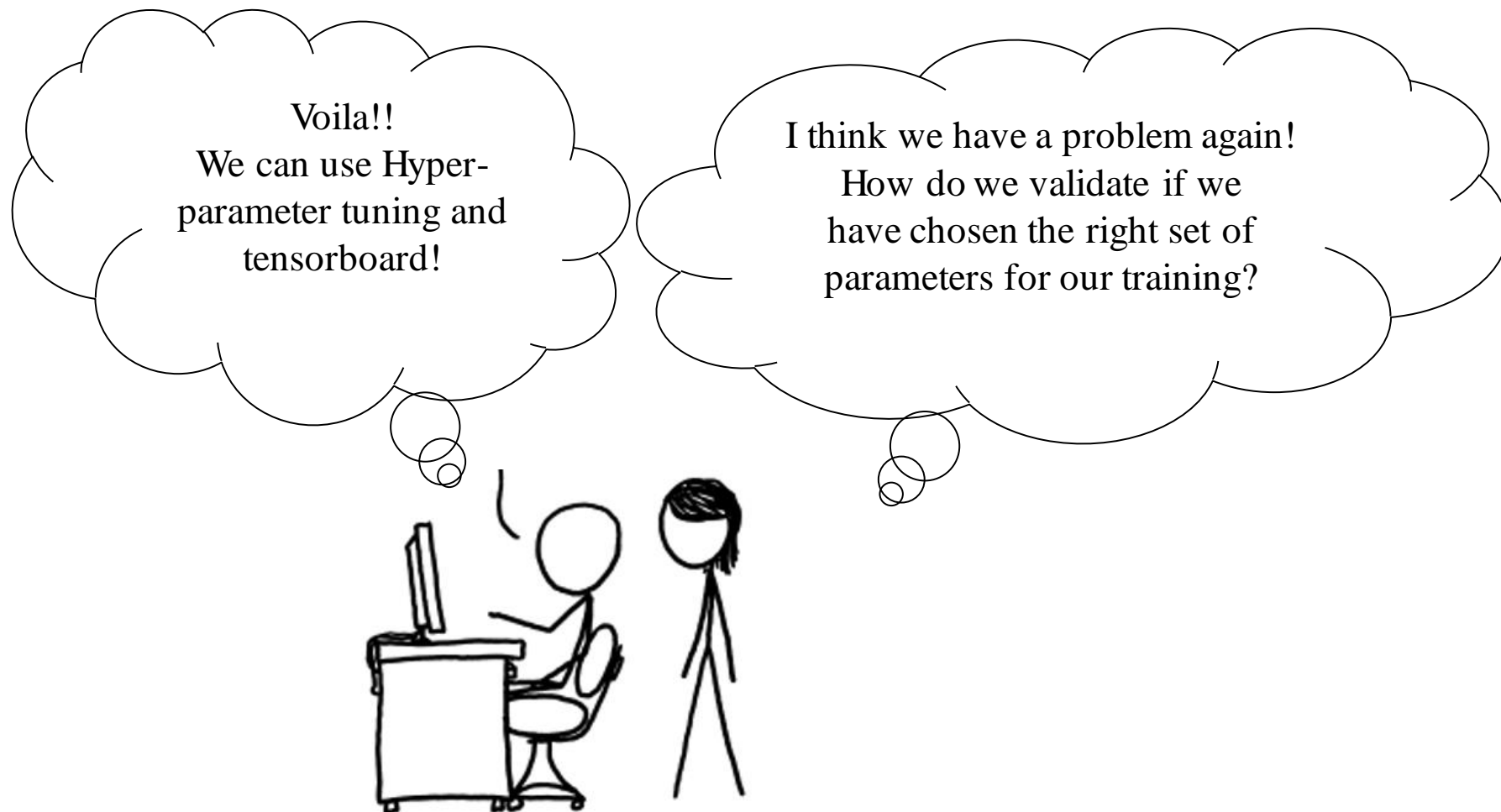


**With Dropout**



The model consists of ,

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





## Hyperparameter Tuning (HPT)

- HP\_OPTIMIZER
- HP\_EPOCHS
- HP\_DENSE\_LAYER
- HP\_DROPOUT

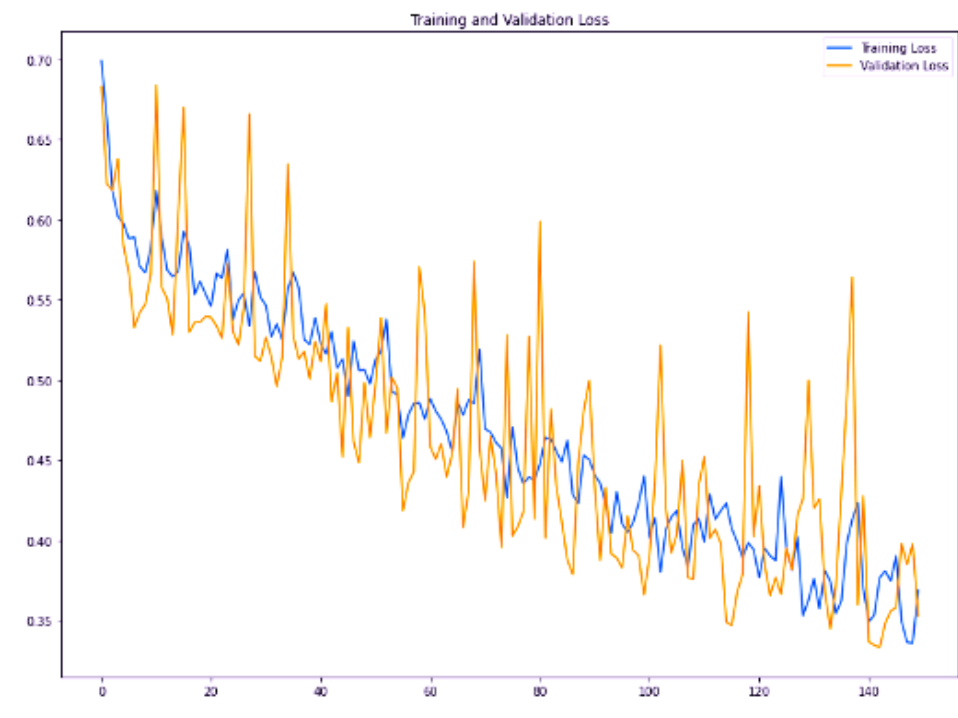
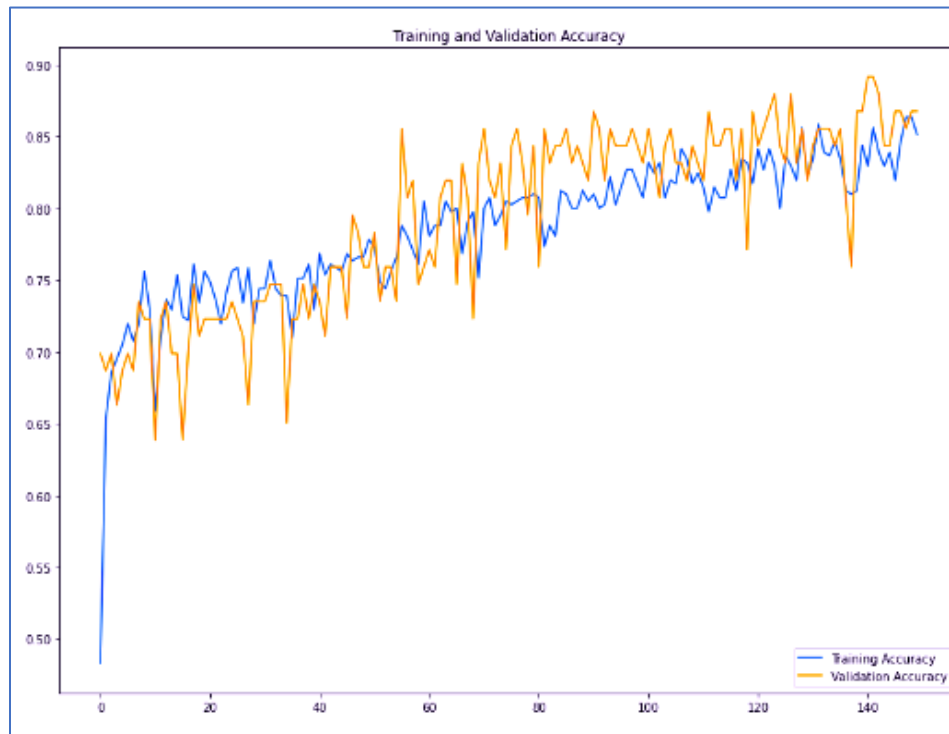
Selection based on HPT

Optimizer - Adam

Number of Epochs - 150

Dense layer - 512

Dropout - 0.4, 0.5



*Train and Validation Accuracy and Loss*

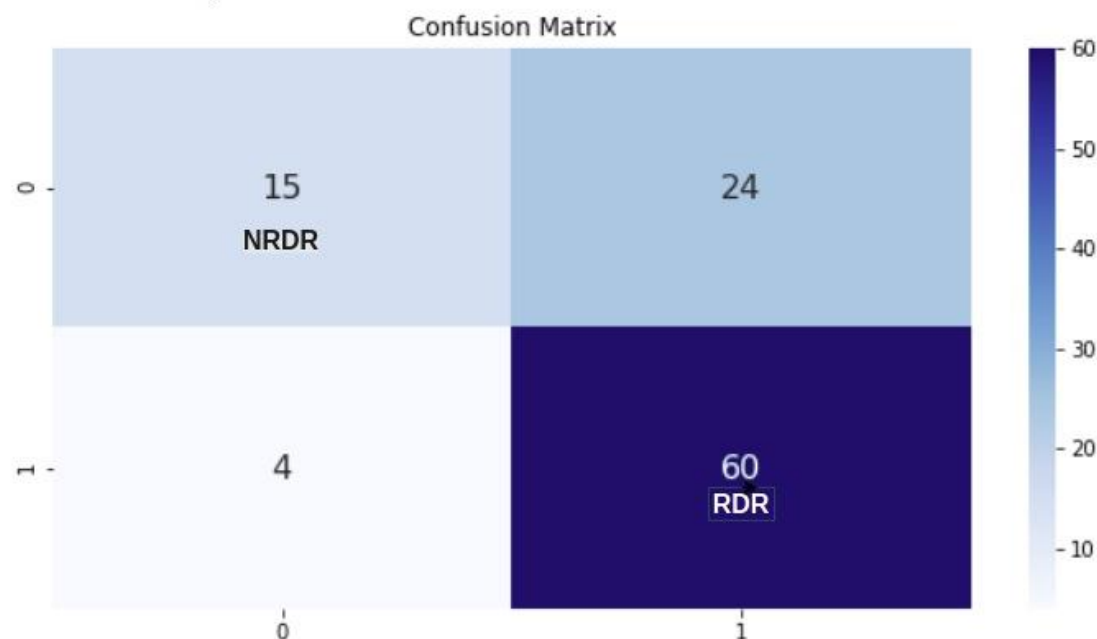
## Metrics

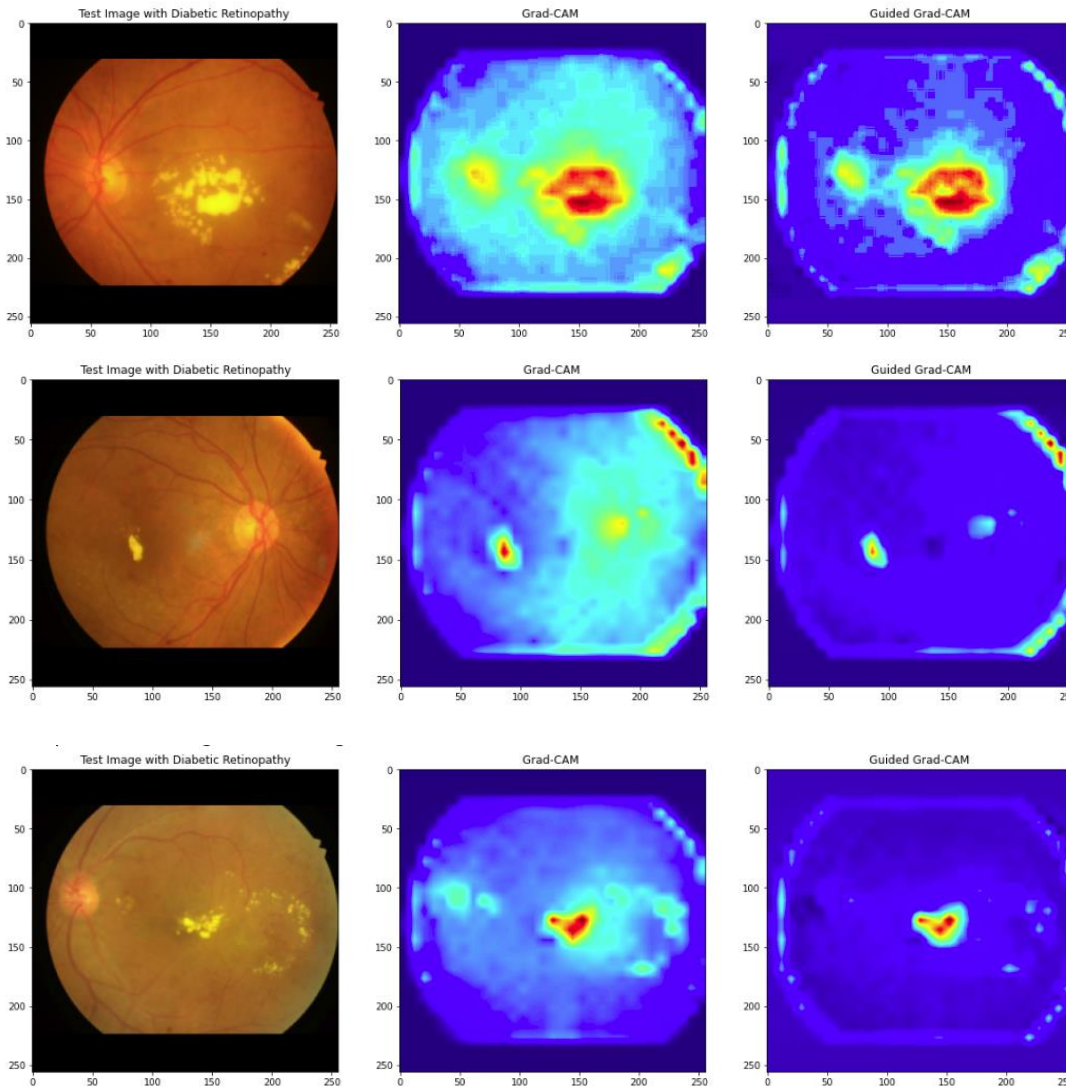
**Confusion Matrix** : Describes the performance of the model

The final achieved test accuracy is about **72.81%**.

		Predicted class	
		<i>P</i>	<i>N</i>
Actual Class	<i>P</i>	True Positives (TP)	False Negatives (FN)
	<i>N</i>	False Positives (FP)	True Negatives (TN)

Test Accuracy: 0.7281553398058253





## 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 | Type of Diabetics
- Drug used – Insulin and Oral

## References

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- [1] [https://www.tensorflow.org/tutorials/load\\_data/images](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