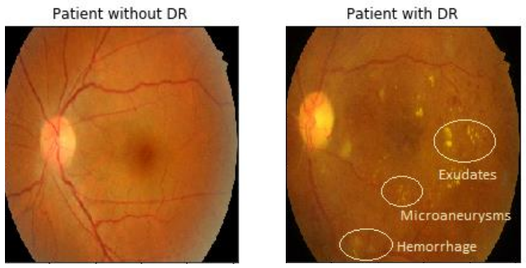
# DIABETIC RETINOPATHY DETECTION

**Kaiwalya Belsare and Gauri Rasane**

Institute of Signal Processing and System Theory, University of Stuttgart, Germany

## 1. Motivation

- Diabetic retinopathy (DR) is a visible microvascular complication in the human retina caused due to diabetes.
- DR if undetected in early stages might lead to an advanced vision-threatening stage.
- Diagnosis of DR is based on assessment of colour fundus images by trained retina specialist.




- But: diagnosis results are based on experience of the professional, also in-person expert examination of pandemic diabetic population is unfeasible.

→ Goal: automatic DR detection based on **deep convolutional neural network** for binary classification, **referable DR (RDR)** and **non referable DR (NRDR)**.

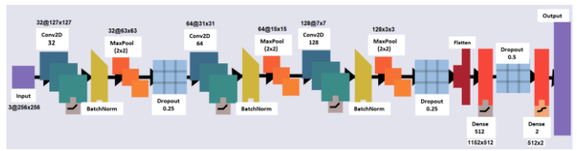
## 2. Proposed method

### 2.1 Input data pipeline

- Use of publicly available dataset, IDRID which consists of retinal fundus images split into training set and test set.
- Every image is associated with it's respective severity grade (0-4) of DR.
- Ground truth labels from original dataset are reformulated as non referable DR (grade 0, 1) and referable DR (grade 2, 3, 4).
- Data pre-processing involves operations i.e. image crop & resize (256x256x3), building datasets (train, test, validate) with image-label pairs.


- Data imbalance is handled by oversampling the minority class through data augmentation techniques such as rotation, horizontal flip and zoom.

### 2.2 Model architecture



- Model consists of cascade of 2D CNN layers followed by batch normalization layer and max pooling layer.
- Activation function for convolutional layers and last dense layer are ReLU and softmax respectively.
- Dropout layers and l2 kernel regularizer are introduced in order to tackle overfitting.

### 2.3 Training

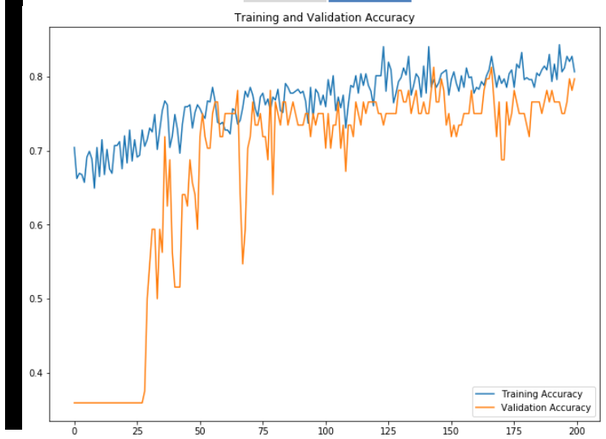
- Hyperparameters namely optimizer, training epochs and neurons in dense layer are optimized with the help of tensorboard.
- DNN model is trained for 200 epochs with SGD as optimizer with a learning rate of 0.001.
- Loss function used is sparse categorical cross entropy loss.

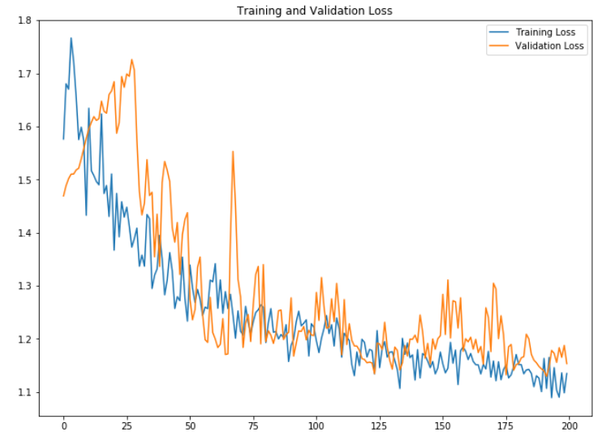
## 3. Evaluation

### Metrics

- The trained DNN model evaluated over the test dataset results with an accuracy of **72.75%**.
- Confusion matrix

| | NRDR | RDR |
|---|---|---|
| NRDR | 25 | 14 |
| RDR | 14 | 50 |



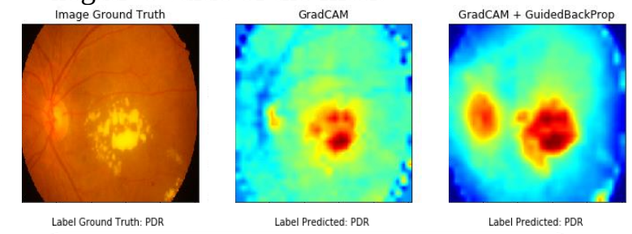

## 4. Deep Visualization

### 4.1 Grad-CAM

- Grad-CAM uses the gradient of the classification score with respect to the last convolutional layer in a network in order to understand which parts of the image are most important for classification.

### 4.2 Guided Backpropagation

- Guided Backpropagation eliminates elements that act negatively towards the decision, by zeroing-out the gradients associated with a negative value of the filter.




## 5. Conclusion

- It is feasible to employ deep learning approaches for the early diagnosis of DR.
- Patients at highest risk of progressive DR can benefit from timely initiation of treatment before irreversible vision loss occurs.

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