I

TH

# EYE DISEASE RECOGNITION TROUGH DEEP LEARNING

Natalia Suárez Díaz - Juan Montenegro Torres

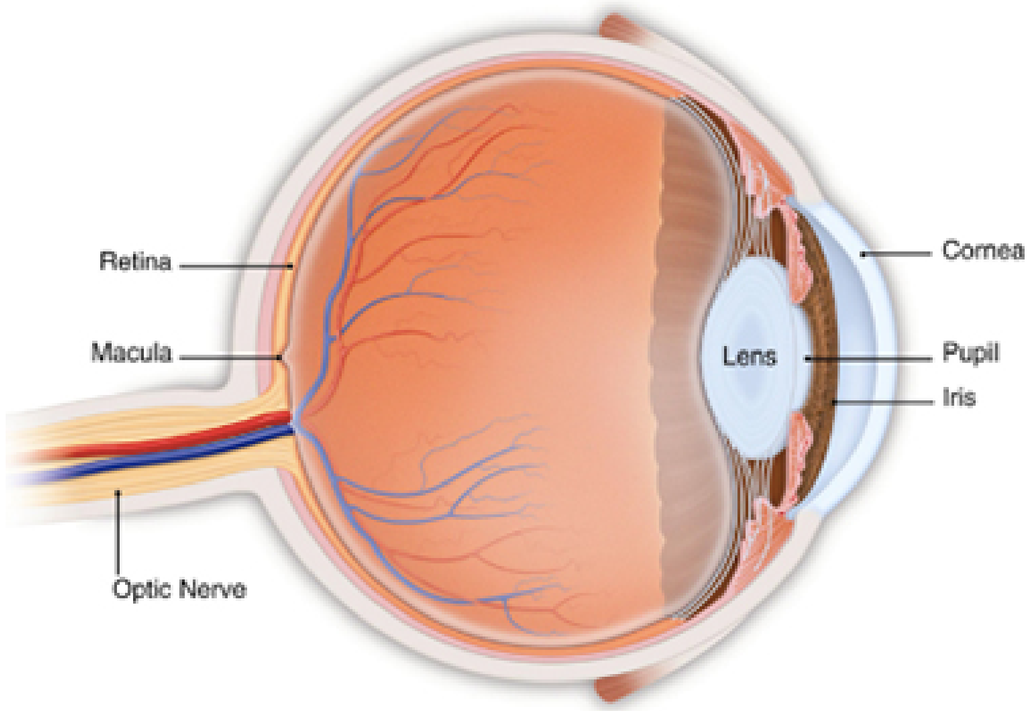
November 30, 2020

II

# RETINA

TH

The retina is an essential part of the eye. It's a thin layer of tissue that covers approximately 65 percent.




The retina job is to receive light from the lens, convert it to neural signals and transmit them to the brain for visual recognition.

# EYE DISEASES

14,4%

"Enfermedades oculares ma's frecuentes en Colombia," Unal.edu.co, Jan. 16, 2018.

2.2 billions of people

World Health Organization: WHO, "Blindness and visual impairment," Who.int, Aug. 15, 2019

1 billion of  people have not yet been diagnosed

# RELATED WORK

Diabetic Retinopathy

## 2012

Priya and Aruna, used SVM and probabilistic network to classify the data between nonproliferative diabetic retinopathy (NPDR) proliferative diabetic retinopathy (PDR) or normal.

97.6%.

## 2016

Harry Pratt, used simple neuronal network to classify the data between Diabetic Retinopathy (DR), moderate DR, severe DR, and proliferative DR.

75%.

# RELATED WORK

## 2019

Guangzhou An et al., used VGG19 neuronal network to create characteristic vectors that would later train a random forest of 10,000 trees to classify the data between Glaucoma or Normal.

93.4%.

## 2018

Yanyan Dong et al., used simple neuronal network to classify the data between normal, slight, medium or severe in cataract's diagnosis

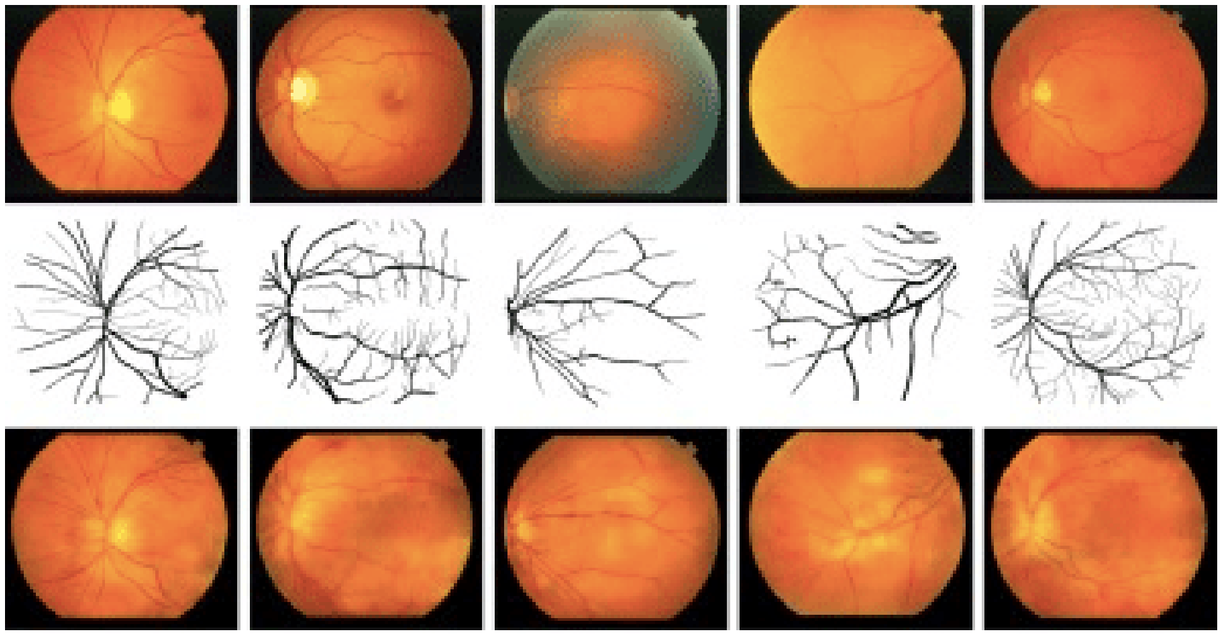
89.9%.

## 2019

ODIR challenge reported 89,9% as the best result.

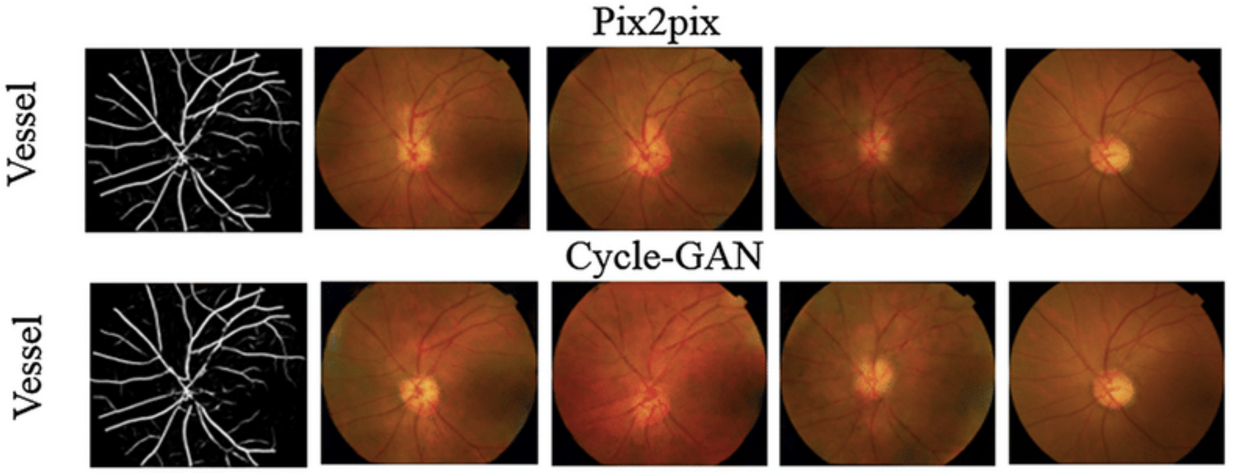
# RELATED WORK

GAN's

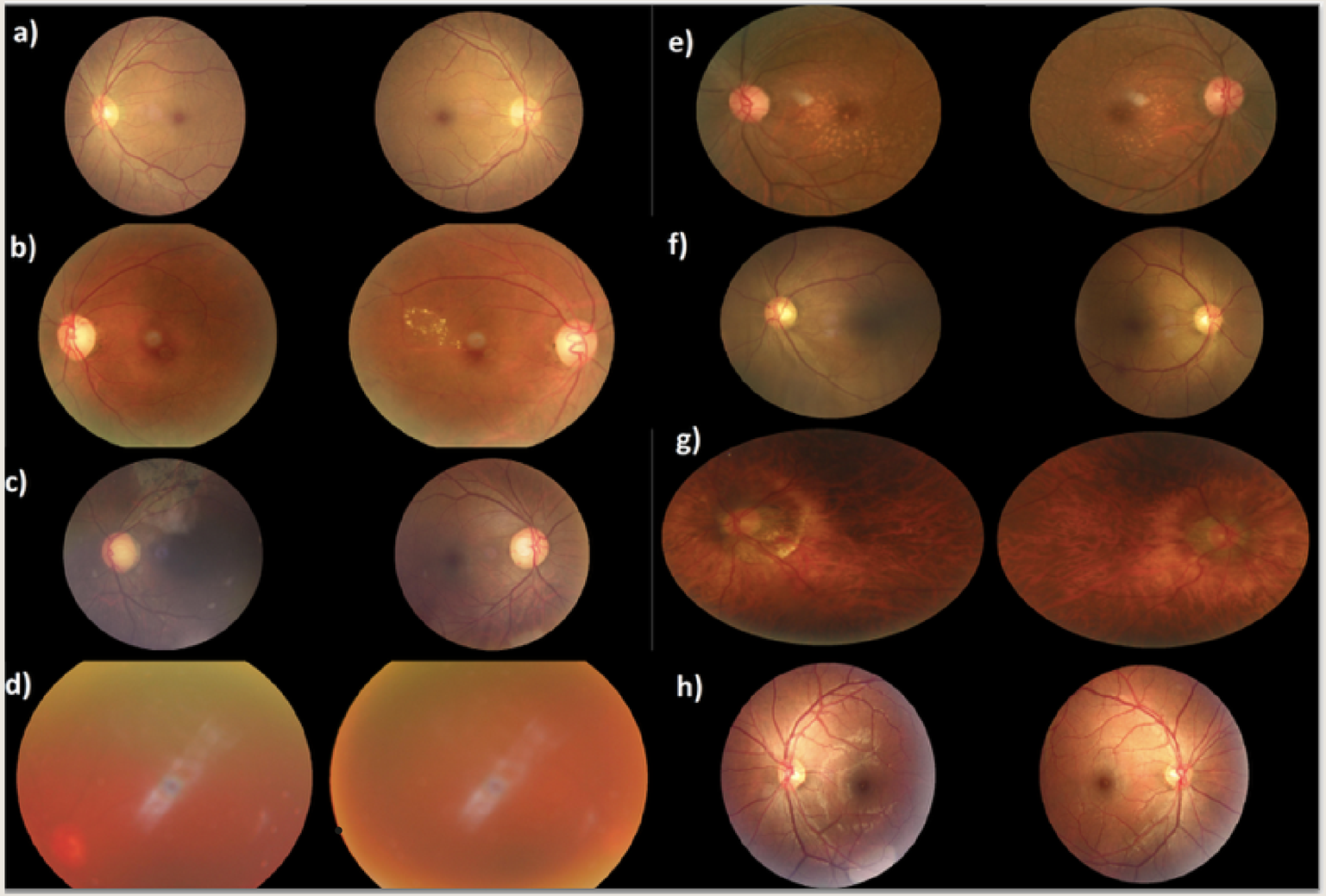


Zhao, Li Maurer, and Chen presented in 2018 a research, which used a TubGAN based in U-NET.

In 2019 Yung, Xiang et. al. presented a framework, where they compare Pix2Pix and Cycle-GAN in the generation of retinal images with different networks in the generator such as U-Net, ResNet-6, and ResNet-9.



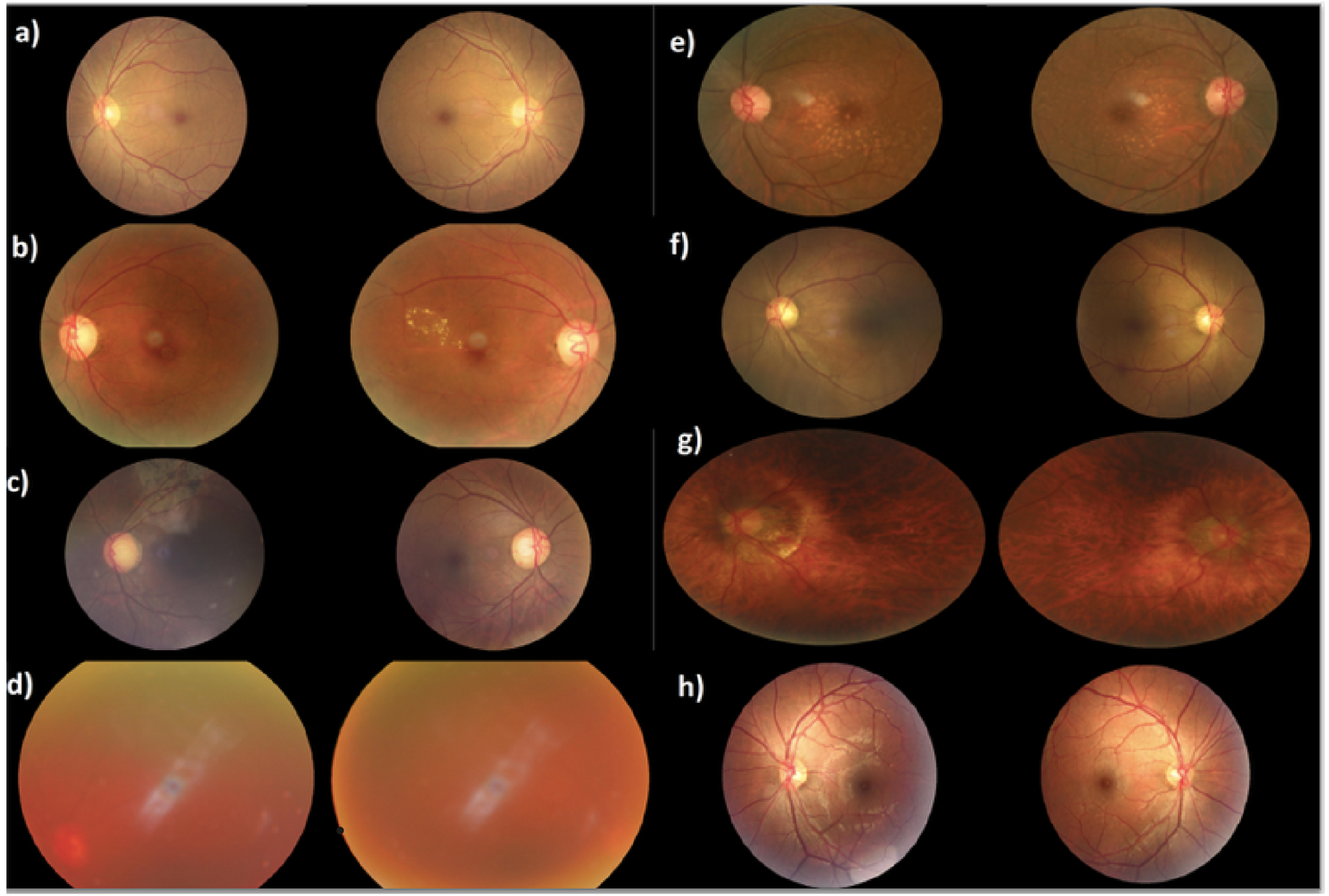
# DATASET




Peking University International Ocular Disease Intelligent Recognition (ODIR) Challenge

a) Normal, b) Diabetes, c)Glaucoma, d)Cataract, e) AMD, f) Hypertension, g) Myopia and h) Other diseases/abnormalitie

# CHALLENGES



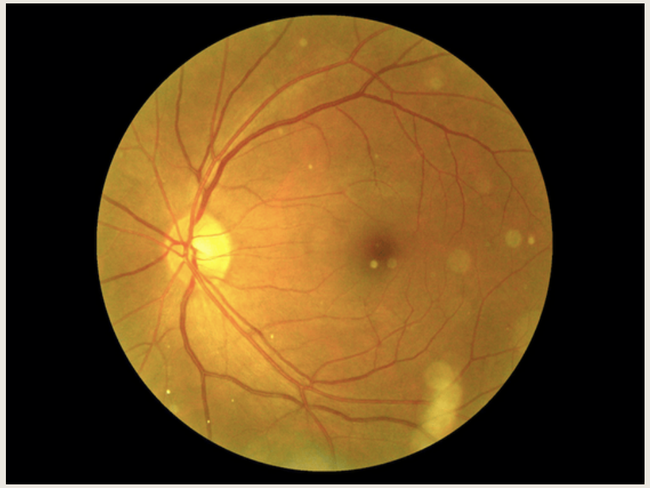

1140 pairs of normal
697 pairs of diabetes
120 pairs of glaucoma
146 pairs of cataracts
117 pairs of AMD
36 pairs of hypertension
107 pairs of myopia
551 pairs of other diseases/abnormalities

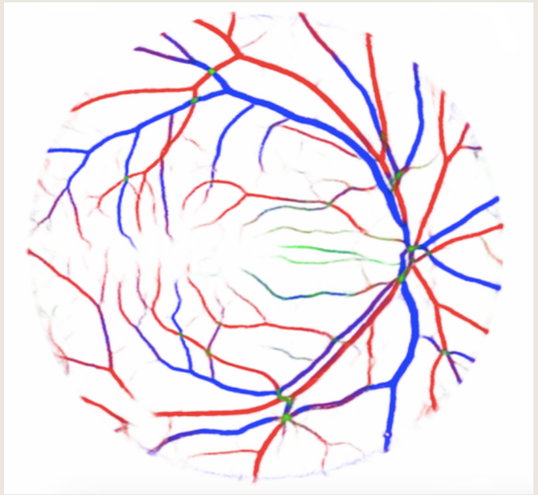
a) Normal, b) Diabetes, c)Glaucoma, d)Cataract, e) AMD, f) Hypertension, g) Myopia and h) Other diseases/abnormalitie

# BASELINE

## Pre-processing

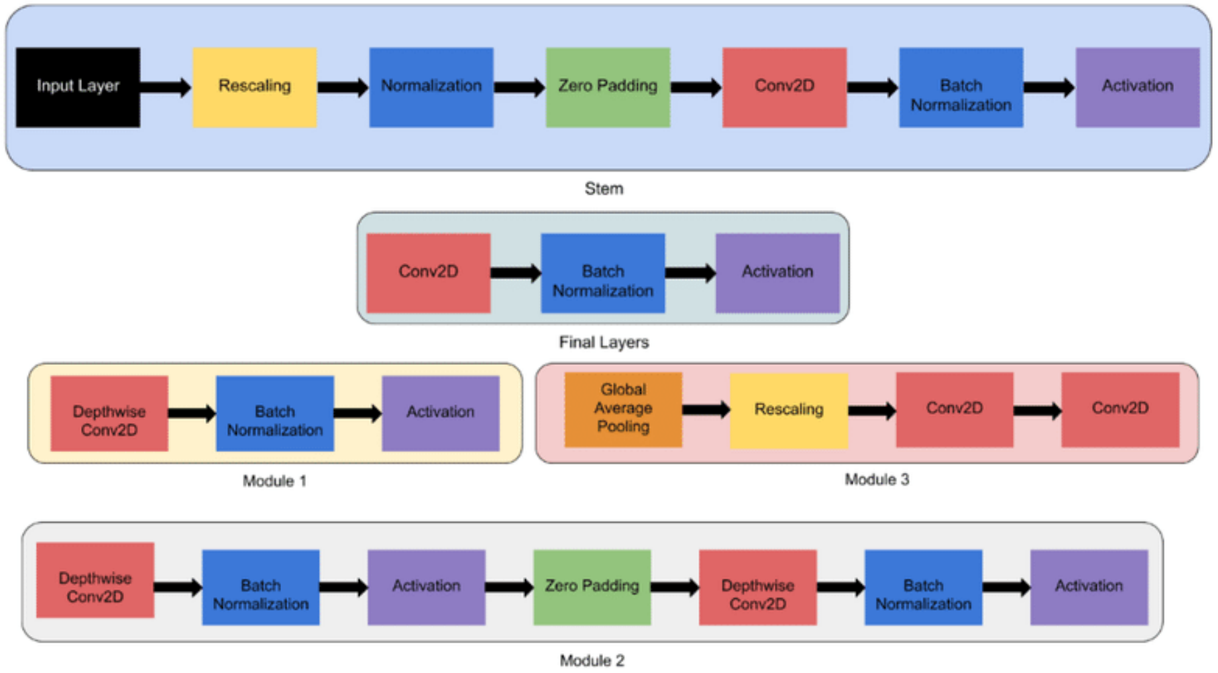






Uncertainty- aware artery/vein classification by Adrian Galdran, M. Meyer, P. Costa,

# BASELINE





EfficientNet B5 Archicteture

# BASELINE

## Results



| Network | F1-score |
|---|---|
| EfficientNet B4 | 0.0443 |
| EficcientNet B5 | 0.0456 |
| EfficientNet B6 | 0.0431 |

| EfficientNet B5 | F1-score |
|---|---|
| Pre-trained weights | 0.418 |
| Pre-trained weights + preprocessing | 0.43 |
| SDG Optimizer | 0.398 |
| Learning Rate 1e-6 | 0.29 |
| Learning Rate 1e-4 | 0.357 |
| Segmented Images | 0.393 |

| Category | Threshold | F1-Score |
|---|---|---|
| Normal | 0.42 | 0.36 |
| Diabetes | 0.51 | 0.5 |
| Glaucoma | 0.43 | 0.39 |
| Cataract | 0.46 | 0.48 |
| AMD | 0.42 | 0.45 |
| Hypertension | 0.7 | 0.19 |
| Myopia | 0.51 | 0.73 |
| Others | 0.46 | 0.37 |

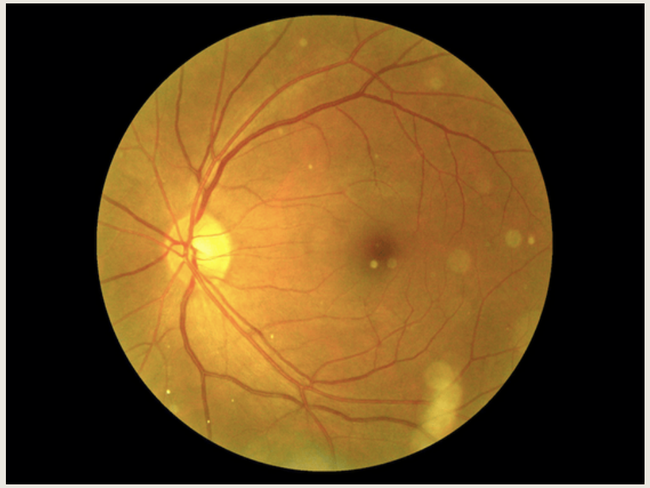
XIII

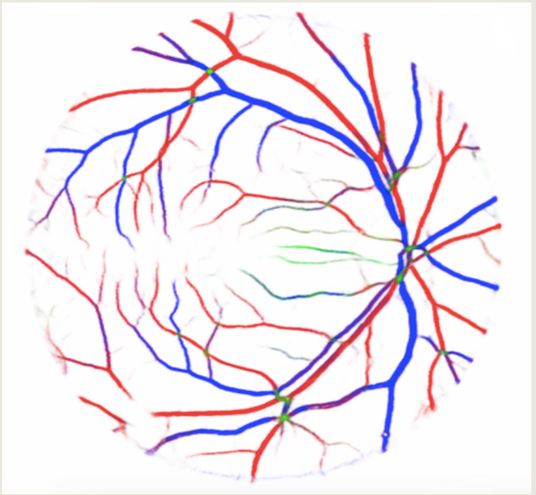
# *PROPOSSED METHOD*

- Pre - Processing
- Architecture
- Validation Experiments
- Evaluation Experiments

# Pre-processing





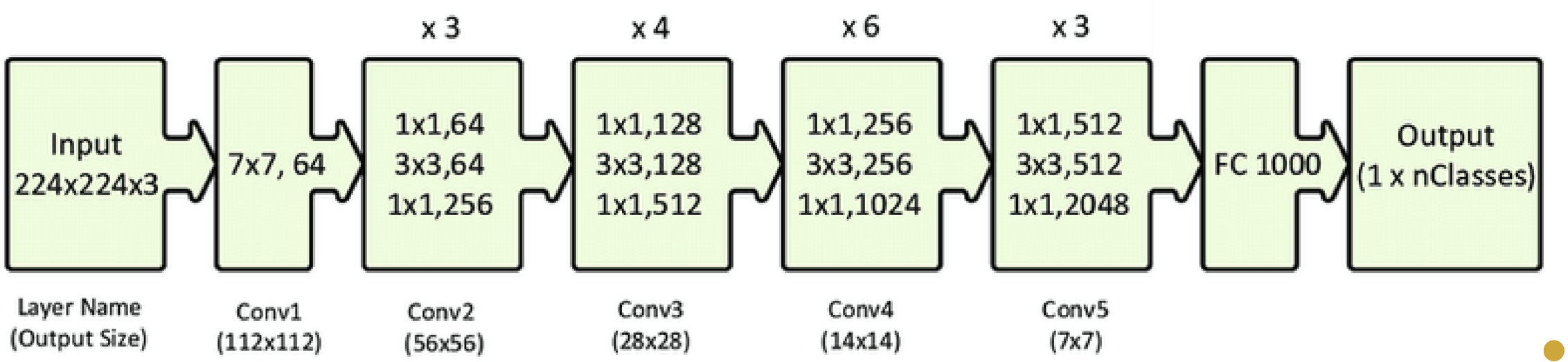


Uncertainty- aware artery/vein classification by Adrian Galdran, M. Meyer, P. Costa,

# ARQUITECTURE

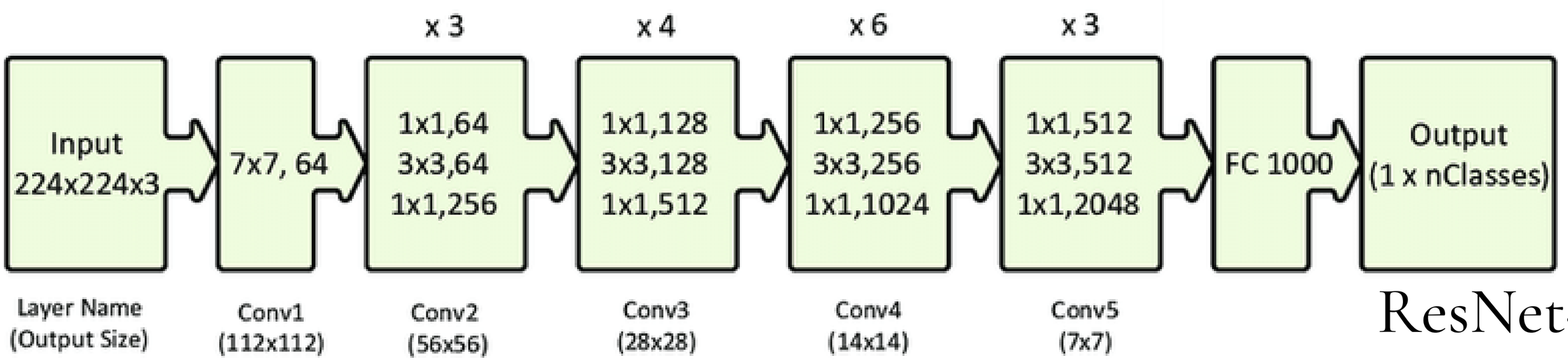
## Ocular Disease Intelligent Recognition Through Deep Learning Architectures

This repository contains Jordi Corbilla's Msc dissertation:
- **Ocular Disease Intelligent recognition through deep learning architectures**, published by Universitat Oberta de Catalunya in 2020 [http://openaccess.uoc.edu/webapps/o2/handle/10609/113126].
The dissertation PDFs and the dissertation sources are licensed under the **Creative Commons Attribution** license, as described in the LICENSE file.




ResNet-50

# ARQUITECTURE




ResNet-50

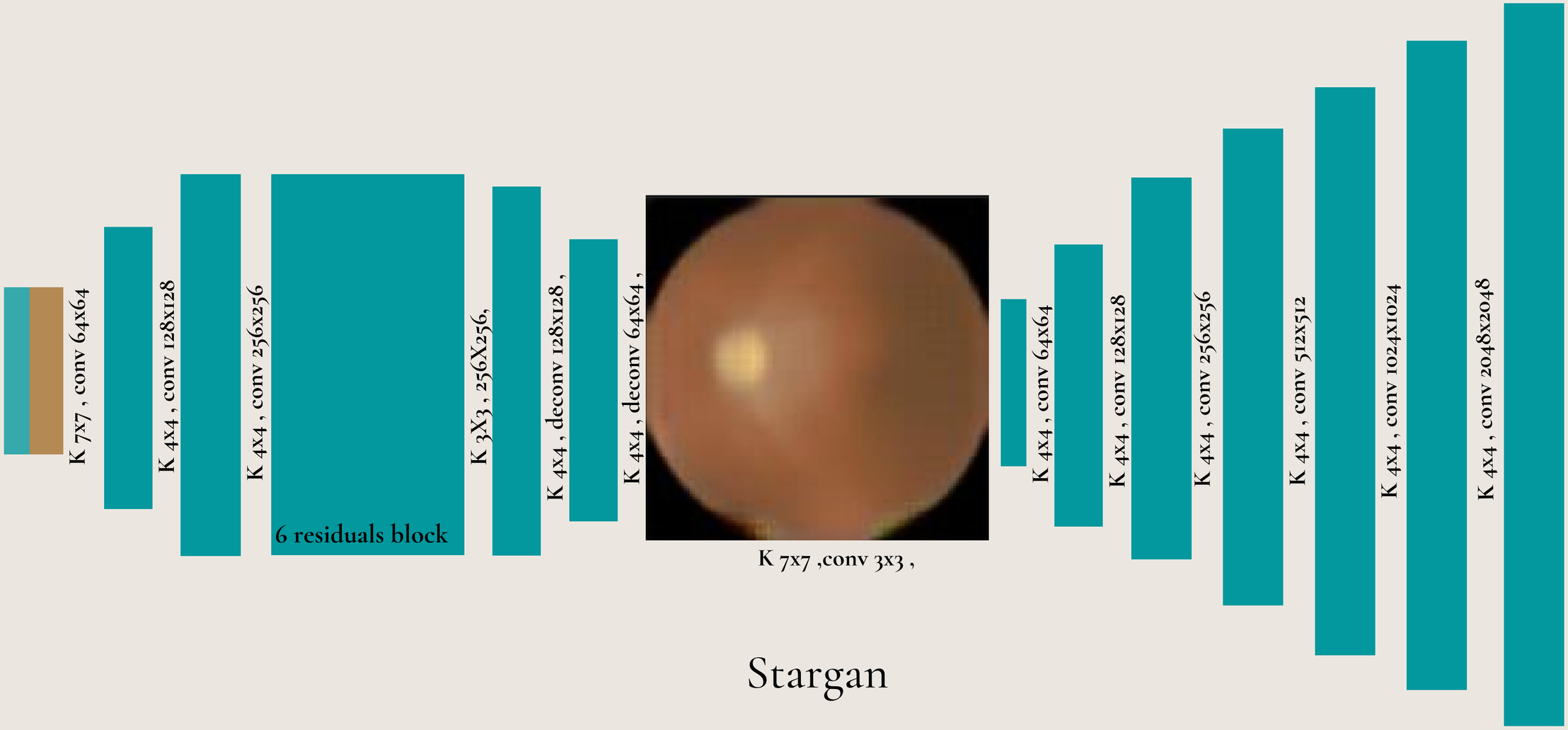
class_weight = 0: 1.,
1: 1.5838,
2: 8.996,
3: 10.24,
4: 10.056,
5: 1.,
6: 1.,
7: 2.5078}

Weight pertained : ImageNet

Loss: Binary cross entropy

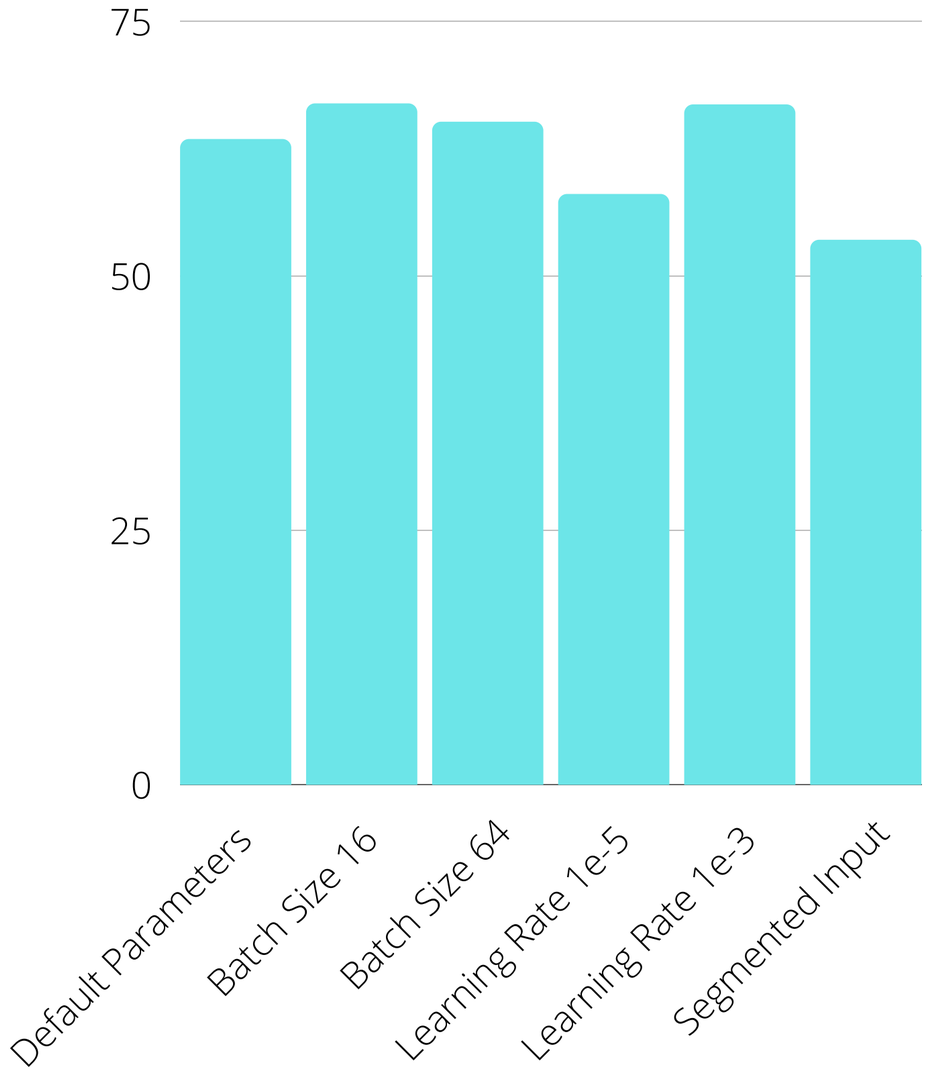
Optimizer: SGD

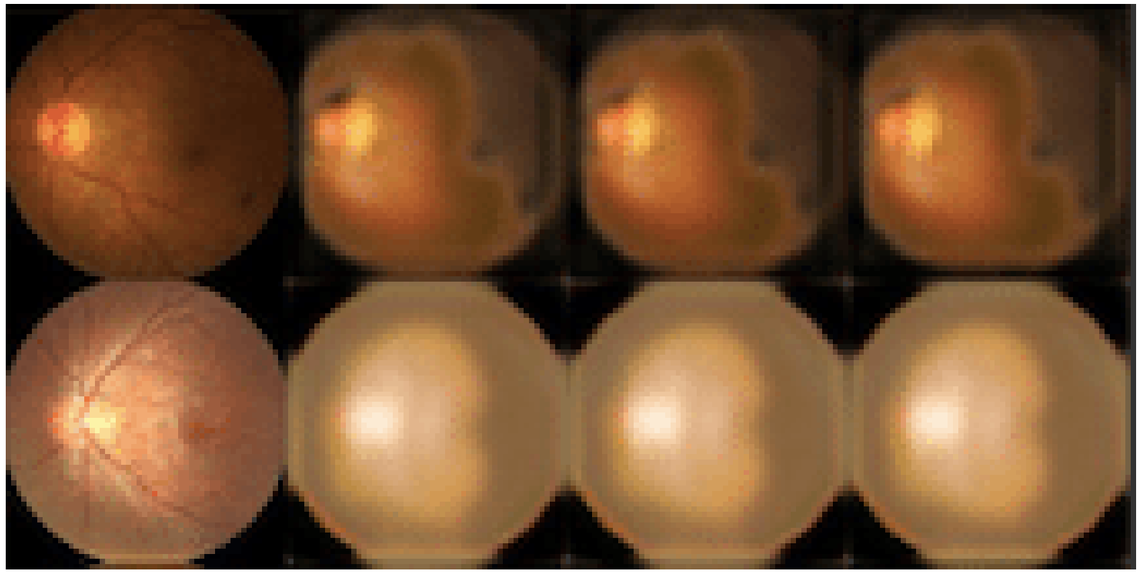
# ARQUITECTURE



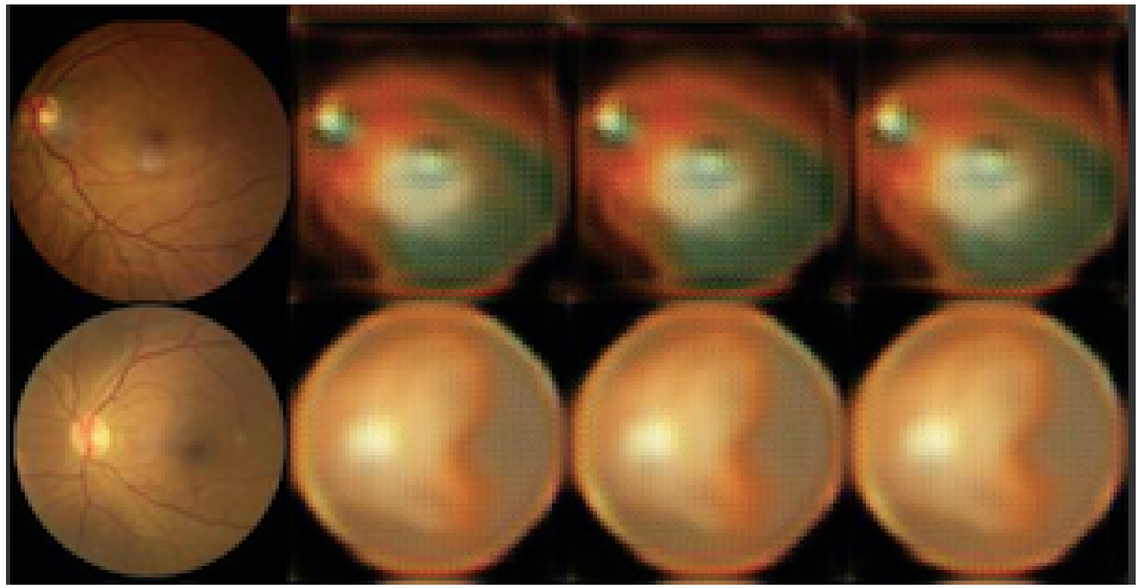

Stargan

# EXPERIMENTS



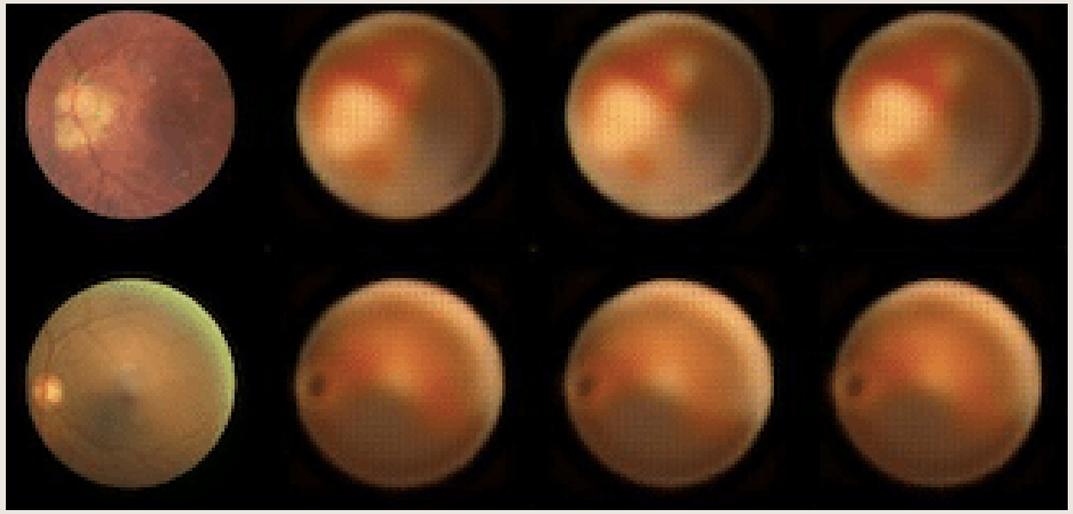



Classification: 1; Reconstruction: 10 ; Gradient penality:10

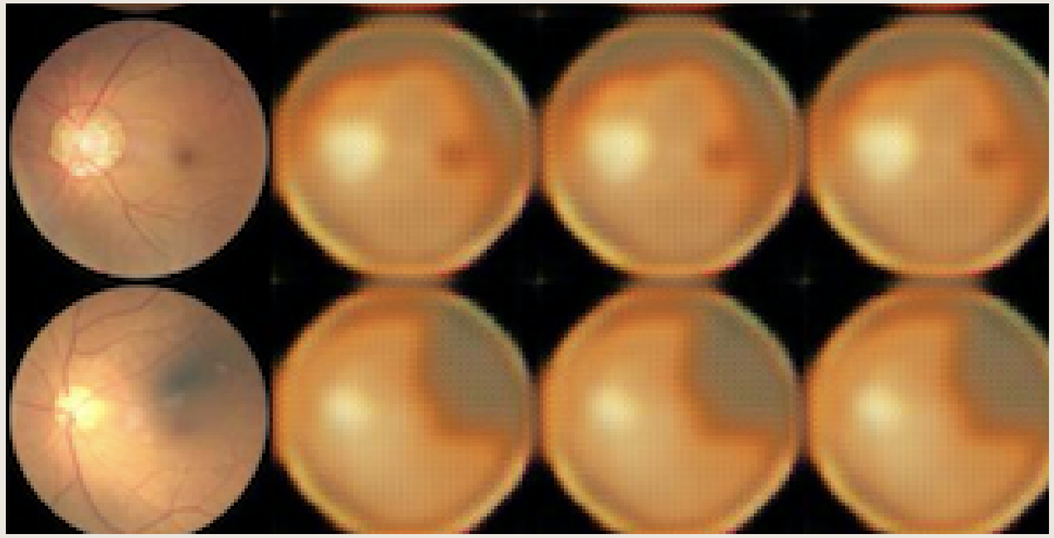


Classification: 1; Reconstruction: 20 ; Gradient penality: 1

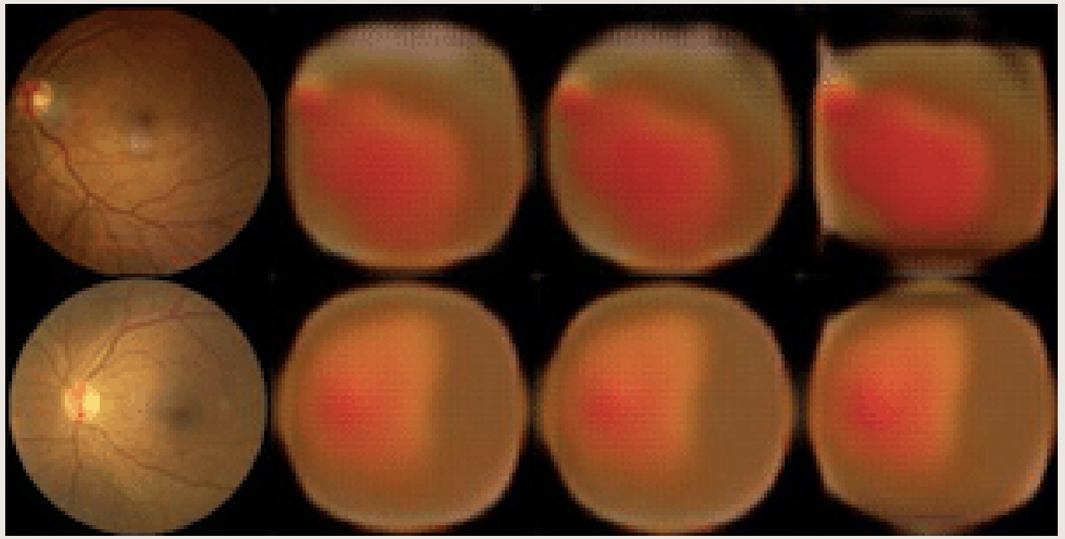
# EXPERIMENTS



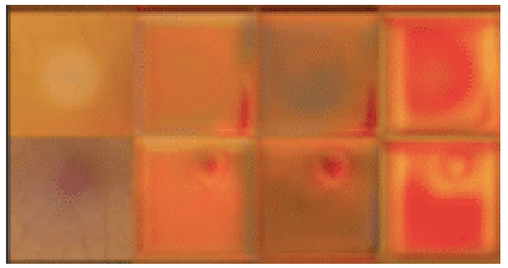
Classification: 1; Reconstruction: 10 ; Gradient penality: 10



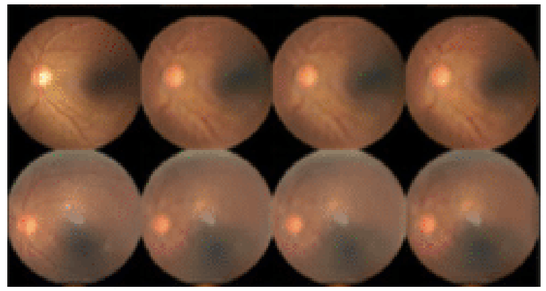
Batchsize 4



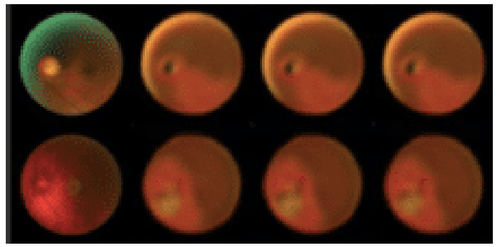
Batchsize 8



(a) Iterations :2000

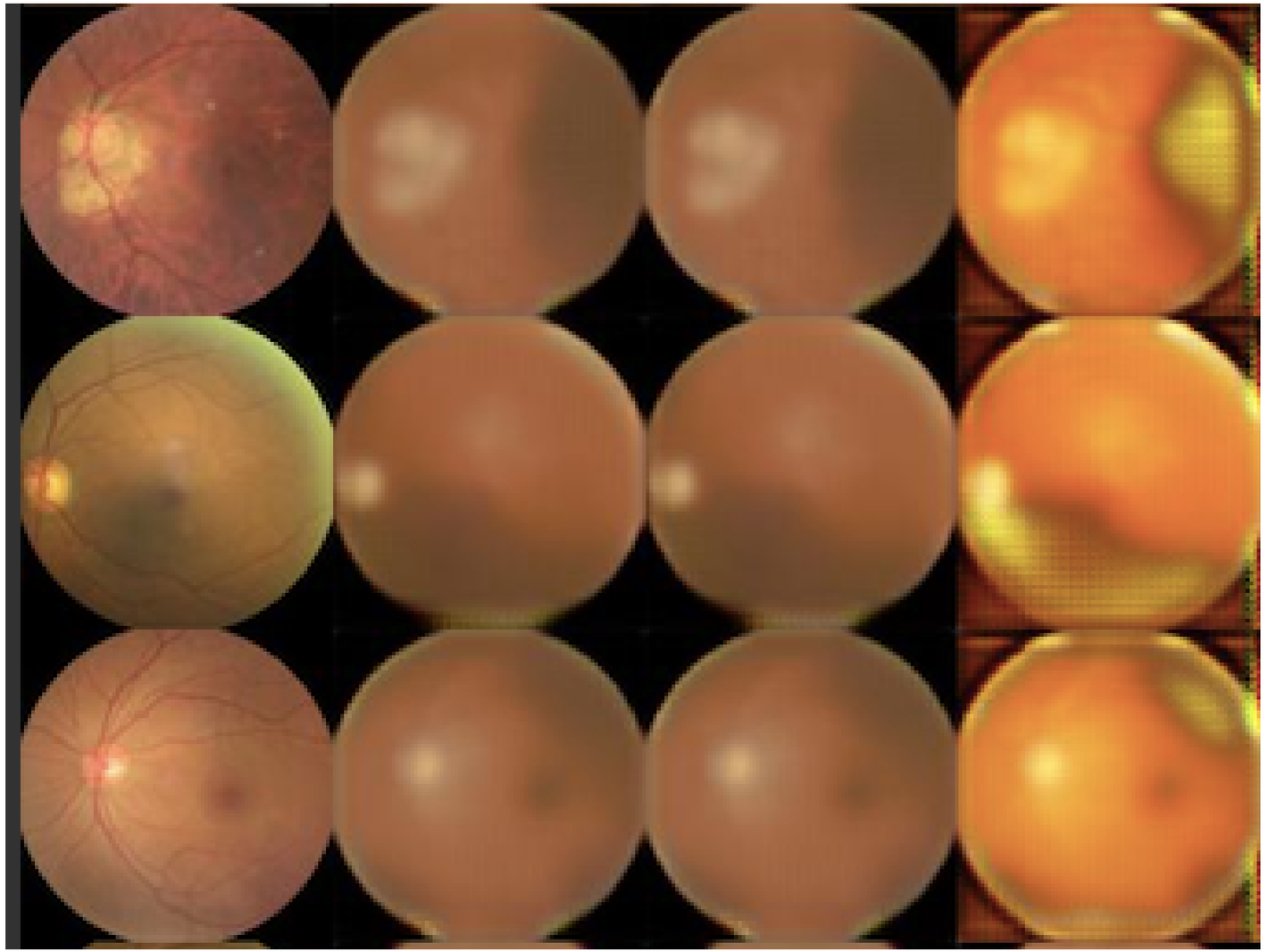


(b) Iterations : 10000

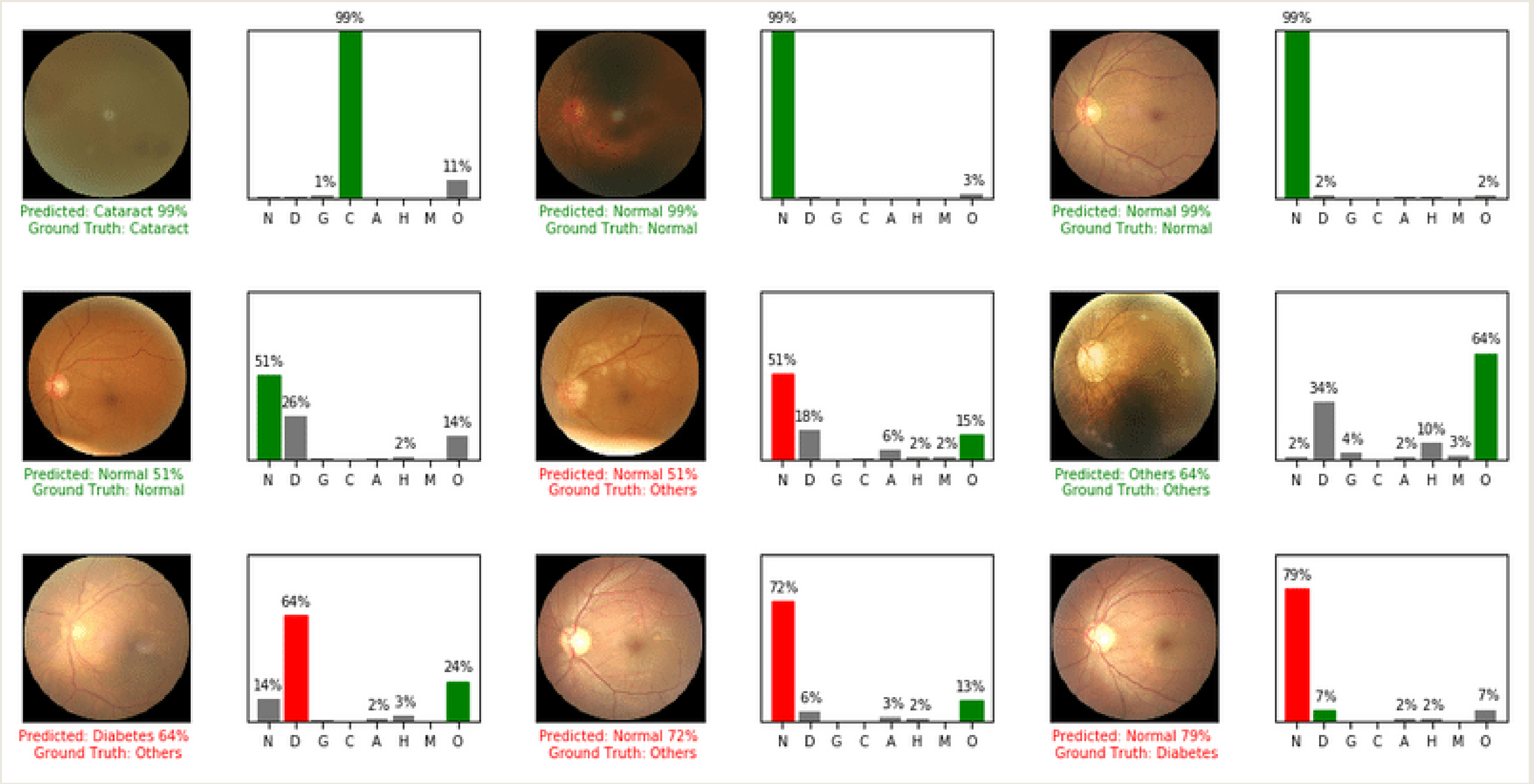


(c) Iterations: 20000

# EXPERIMENTS



# FINAL RESULTS




68,9%

# DISCUSSION

- The classification between the different eye diseases is today a world necessity. This paper sought to provide a solution to it, having a good result.
- EficcieNet did not get a learning of the classification. It can be for the little number of layers and class imbalance
- It was a good option try to use GANs. However the results were not expected although the image have a retina with high resolution, the majority of the experiments have the collapse problem and it only can be changed in Miopia's class with the use of more ReLU layers.
- It beats the baseline method and the state of art due to the generaliza- tion of challenge. Respect the results reported for the ODIR challenge we have a disadvantage of 20% of precision
- We consider that the method used is a good method that needs longer working time to be the best method and trustworthy for the medical community.


THANK
YOU