Look Me in the Eye: APTOS 2019 Blindness Detection

Borys Tymchenko

Senior Computer Vision/Deep Learning Engineer

3DLOOK

[DISCLAIMER]

Competition is still in progress

Sohier Dane

Deadline Extension to September 7

posted in APTOS 2019 Blindness Detection 16 hours ago

31

Be advised that we are extending the deadline by two days. We strive to avoid deadline changes where possible, but given that many users affected by the submission dropout discussed here will not be awake again in time to resubmit by the original deadline this seemed like the fairest option.

Thank you for your understanding, I know that this may be frustrating.

We will not be able to respond to all comments, but rest assured we will continue to monitor the forums and submission run reliability closely.

We are training models right now!

[DISCLAIMER]

This presentation is available at Kaggle Forum, so no

What is APTOS?

- Aravind Eye Hospital in India
- Asia Pacific Tele-Ophthalmology Society (APTOS) Symposium

[ods.ai] Wonderbolts

Borys Tymchenko
Warlock

Phil Marchenko
Fighter

Dmitry Spodarets
Cleric

62	neongen	0.825	90	1d
63	[ods.ai] Wonderbolts	0.825	29	1h

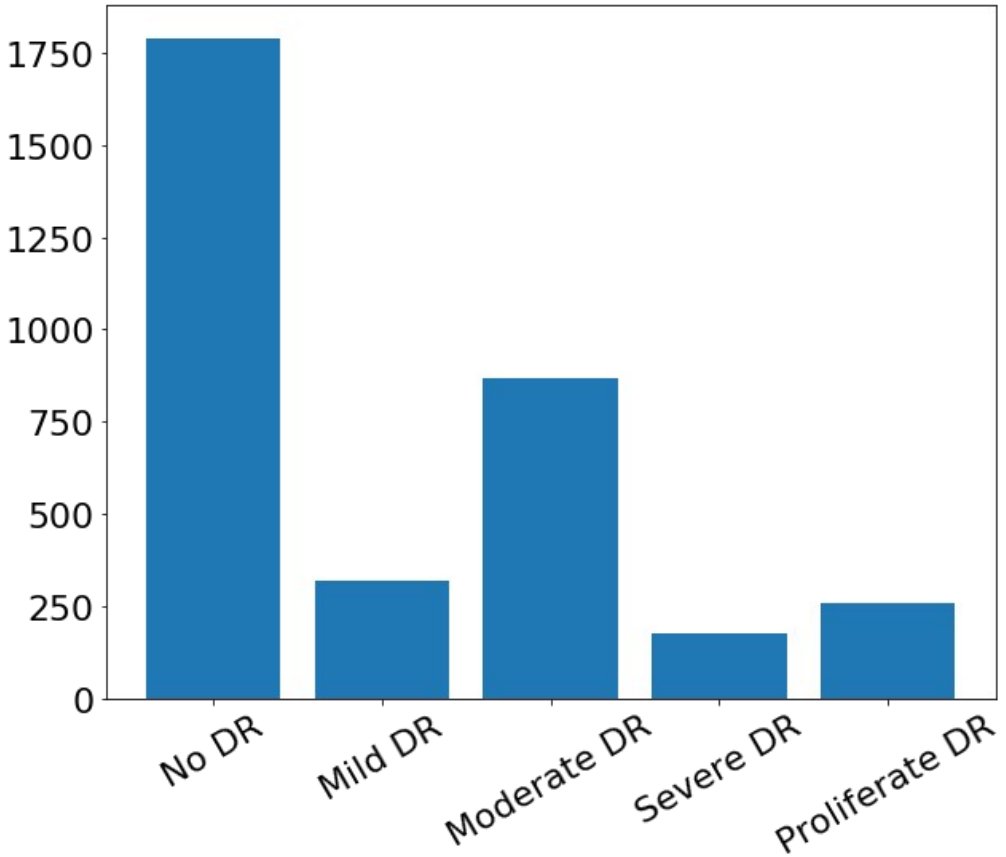
Your Best Entry ↑

Why take part?

- Data looks pretty easy (we thought at first)
- Not that much data (we thought at first)
- Kernel only (we thought at first)
- Entering late (there must be good solutions already)
- Plenty of time left (we thought at first)

What do we have to predict?

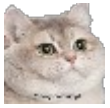
Class of severity of the diabetic retinopathy



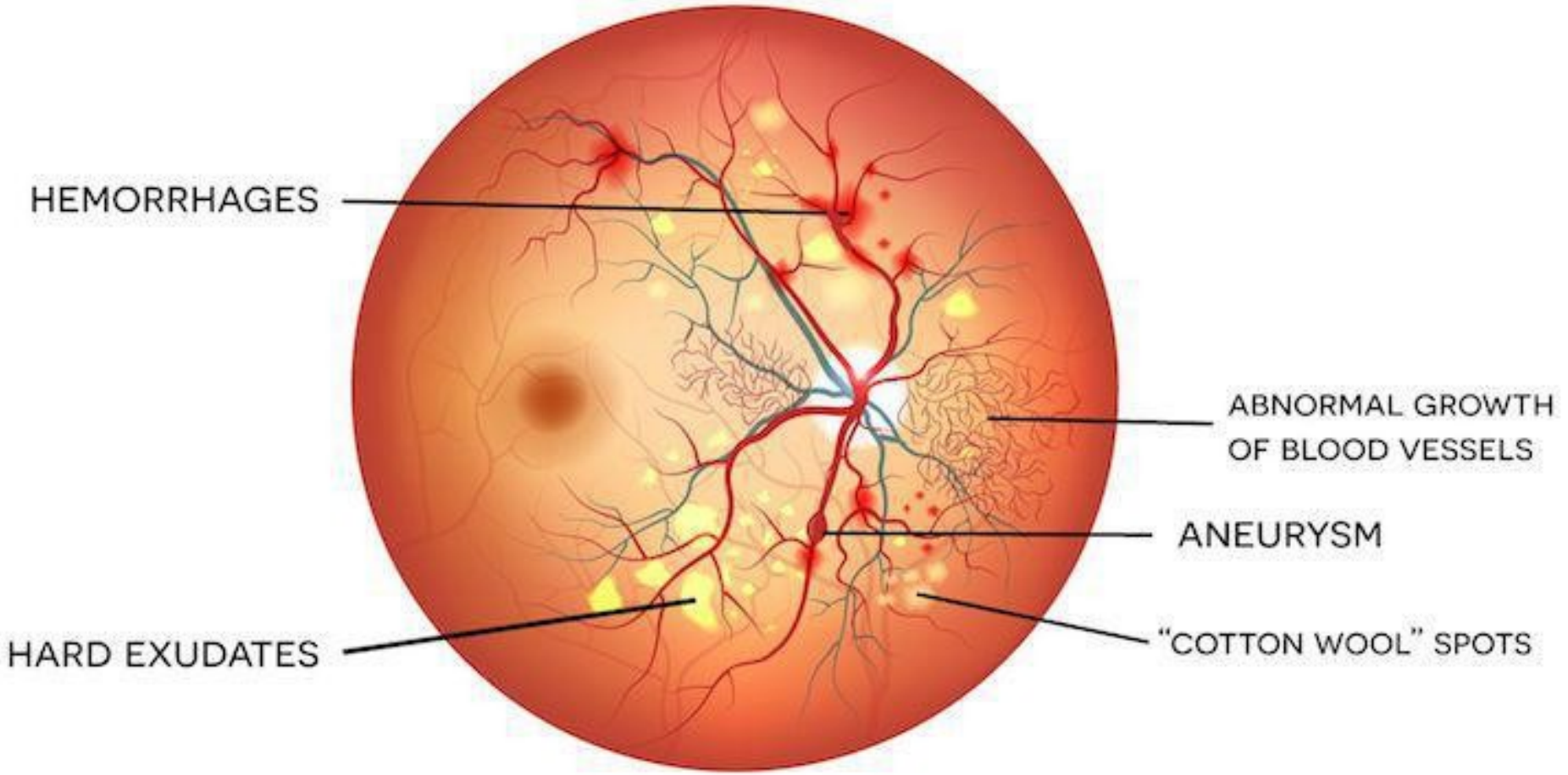
3.6k train data

1.9k public LB

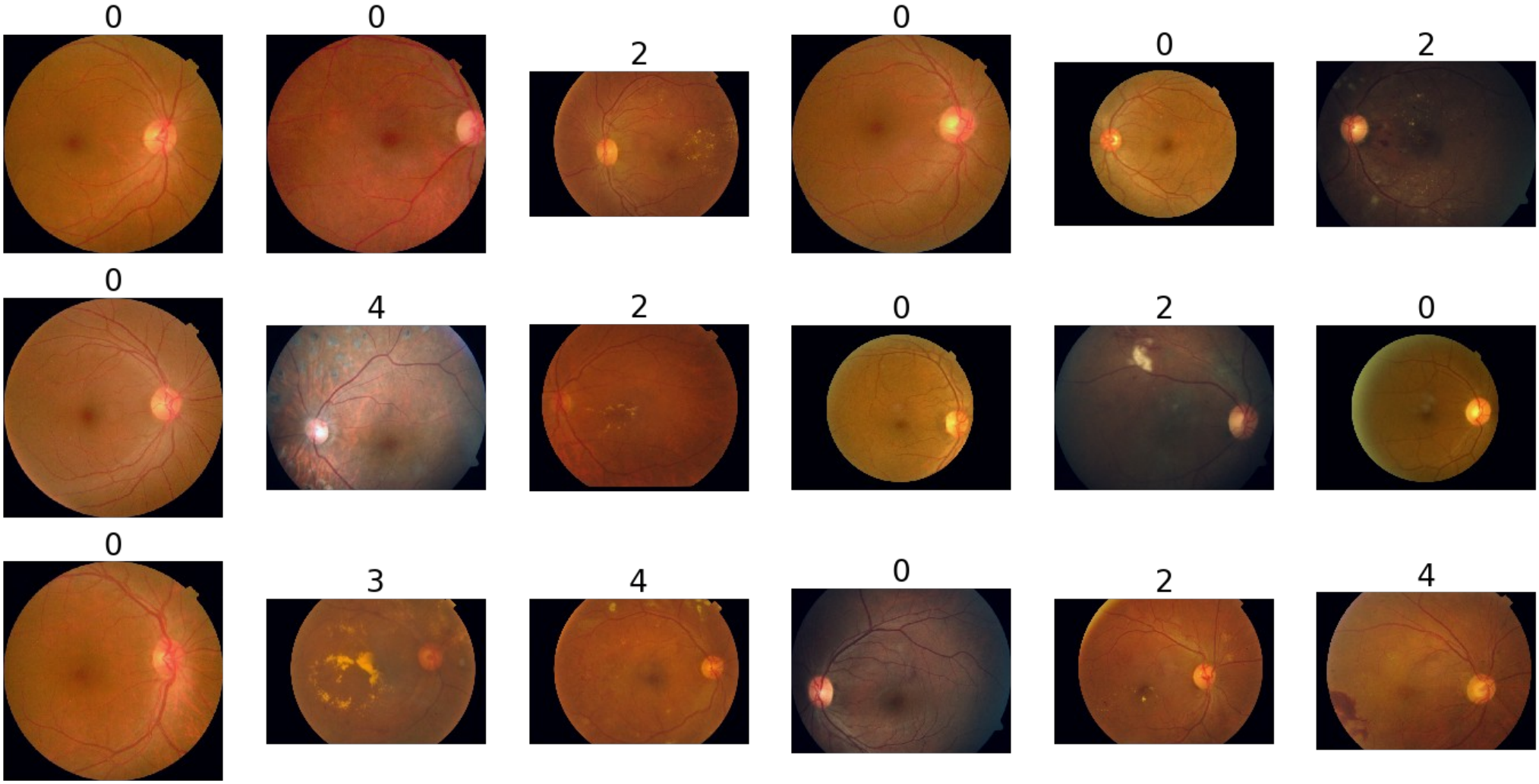
13k private LB



What are the features?



Take a peek on images



Looks nice!

Original size varies from 640x480 to **3120x1910**

What is the metric?

Quadratic weighted Cohen's Kappa

1. Calculate confusion matrix *O*, normalize it
2. Calculate an *NxN* histogram matrix of expected ratings, *E*
3. Calculate weight matrix *W*
4. Calculate Cohen's Kappa

$$w_{ij} = \frac{(i-j)^2}{(n-1)^2} \qquad kappa = 1 - \frac{\sum_{ij} w_{ij} \cdot o_{ij}}{\sum_{ij} w_{ij} \cdot e_{ij}}$$

Compares predicted accuracy to random accuracy

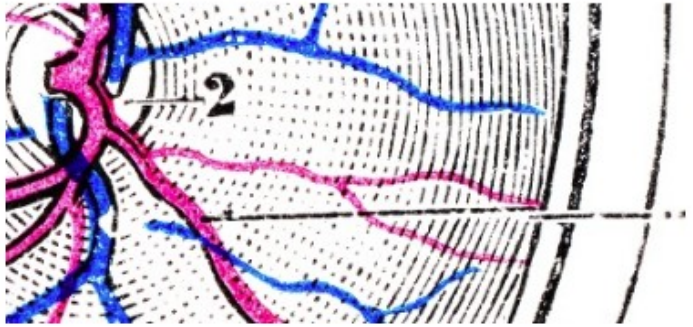
Looks hard
Okay, it correlates well with RMSE

Let us try fit and then predict!

- Keras
- Simple classification
- ResNet34 (and overfits!)
- 224x224

- Score 0.731 on LB
- Public kernel scores 0.796

Identical competition in 2015



Diabetic Retinopathy Detection

Identify signs of diabetic retinopathy in eye images

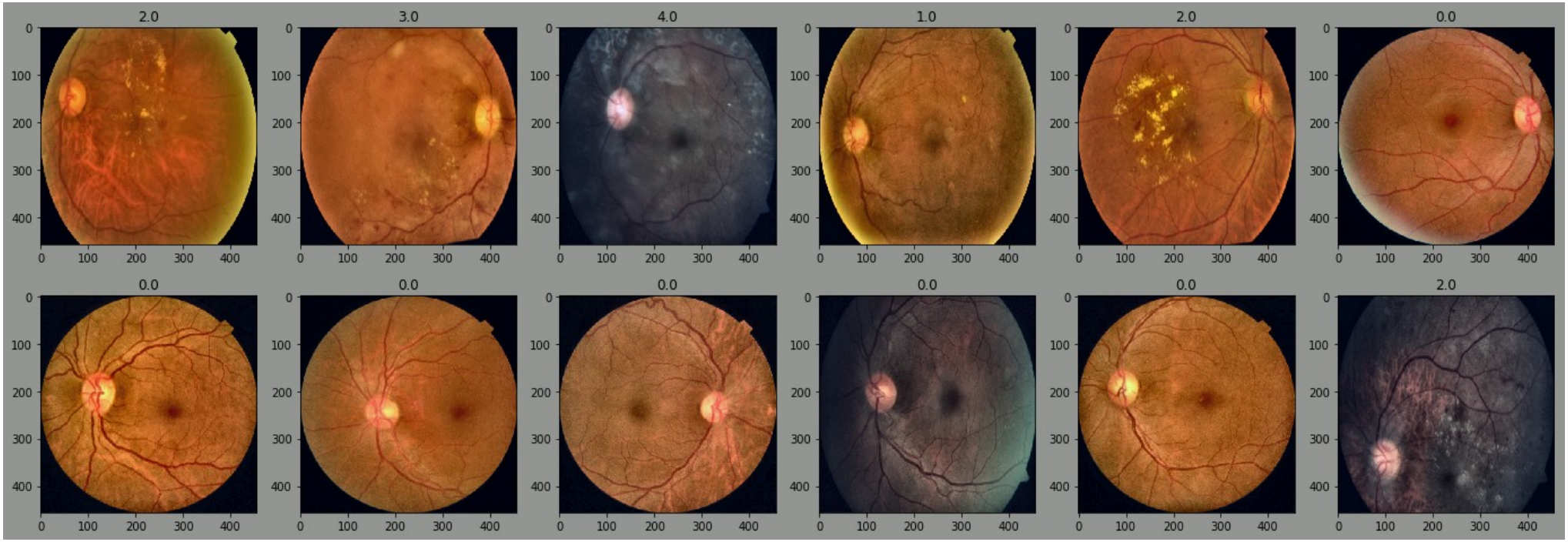
$100,000 · 661 teams · 4 years ago

- Same type of images
- Same labels
- Same metric
- Available solutions of top places

- American citizens

We need some kind of preprocesing

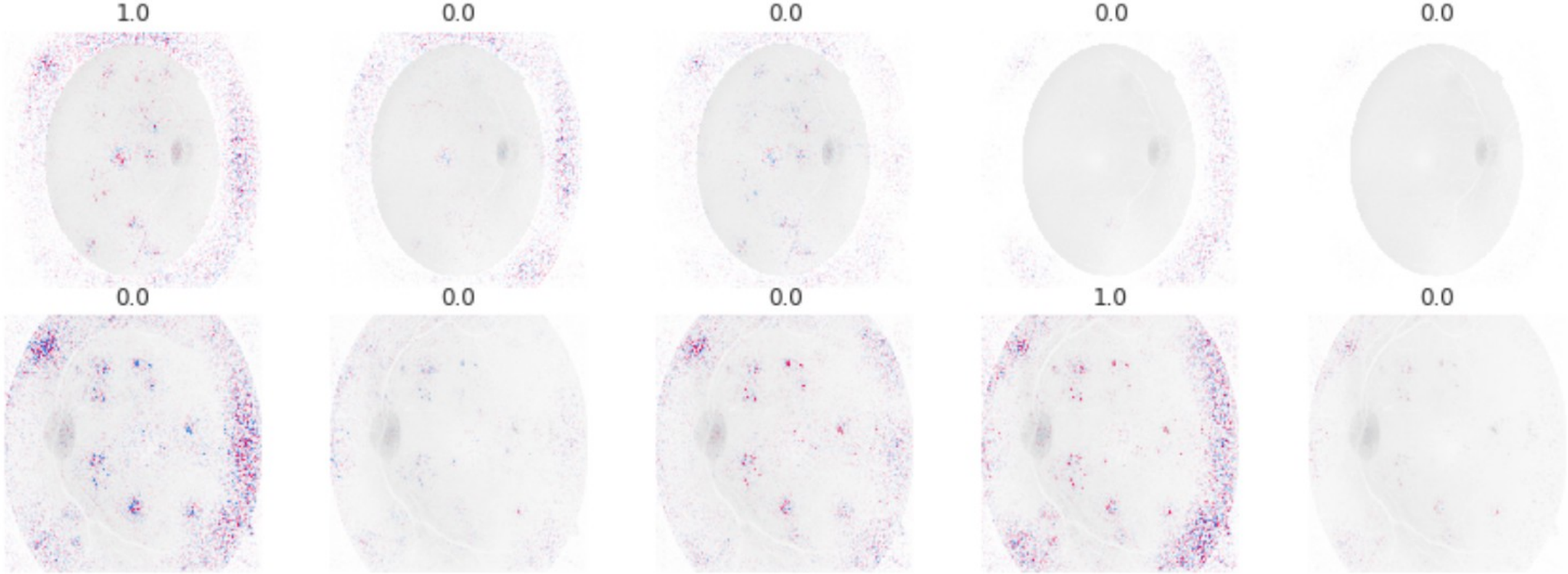
Crop the eye tightly



Looks nice

[MESSAGE FROM THE FORUM]

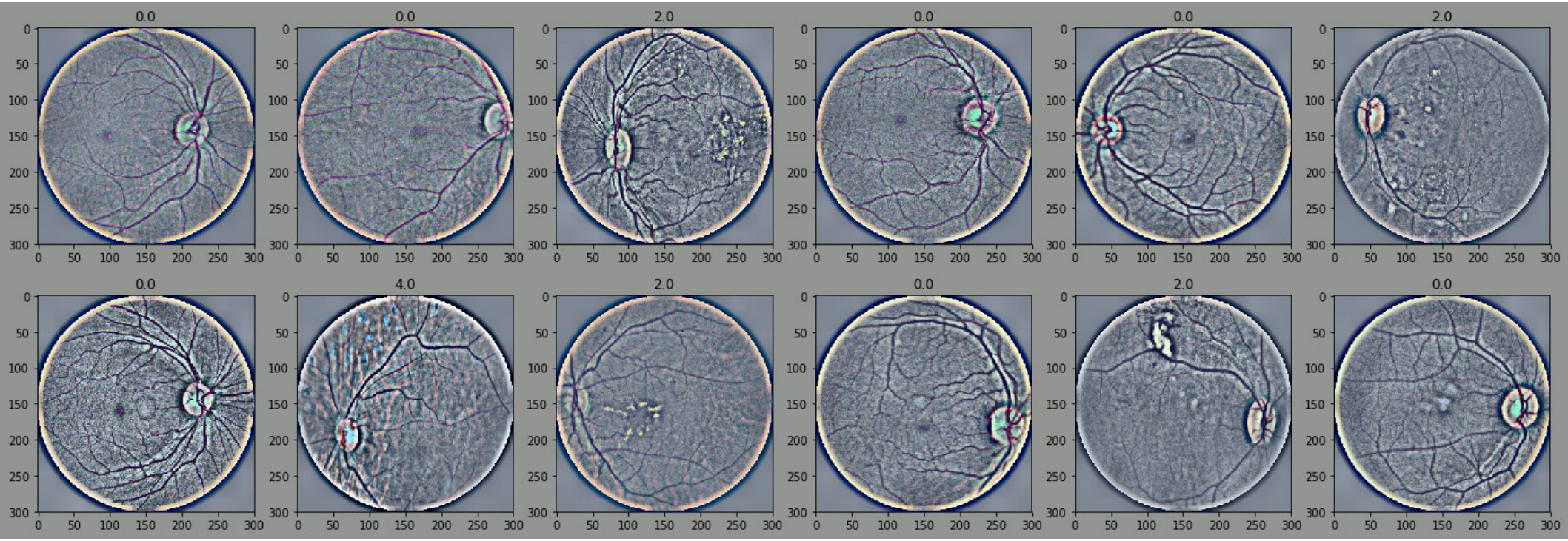
Image size correlates well with diagnosis
This does not work for test data
Kernel with info only about image size scores 0.7+ on LB



Source: bit.ly/2m0GMiF

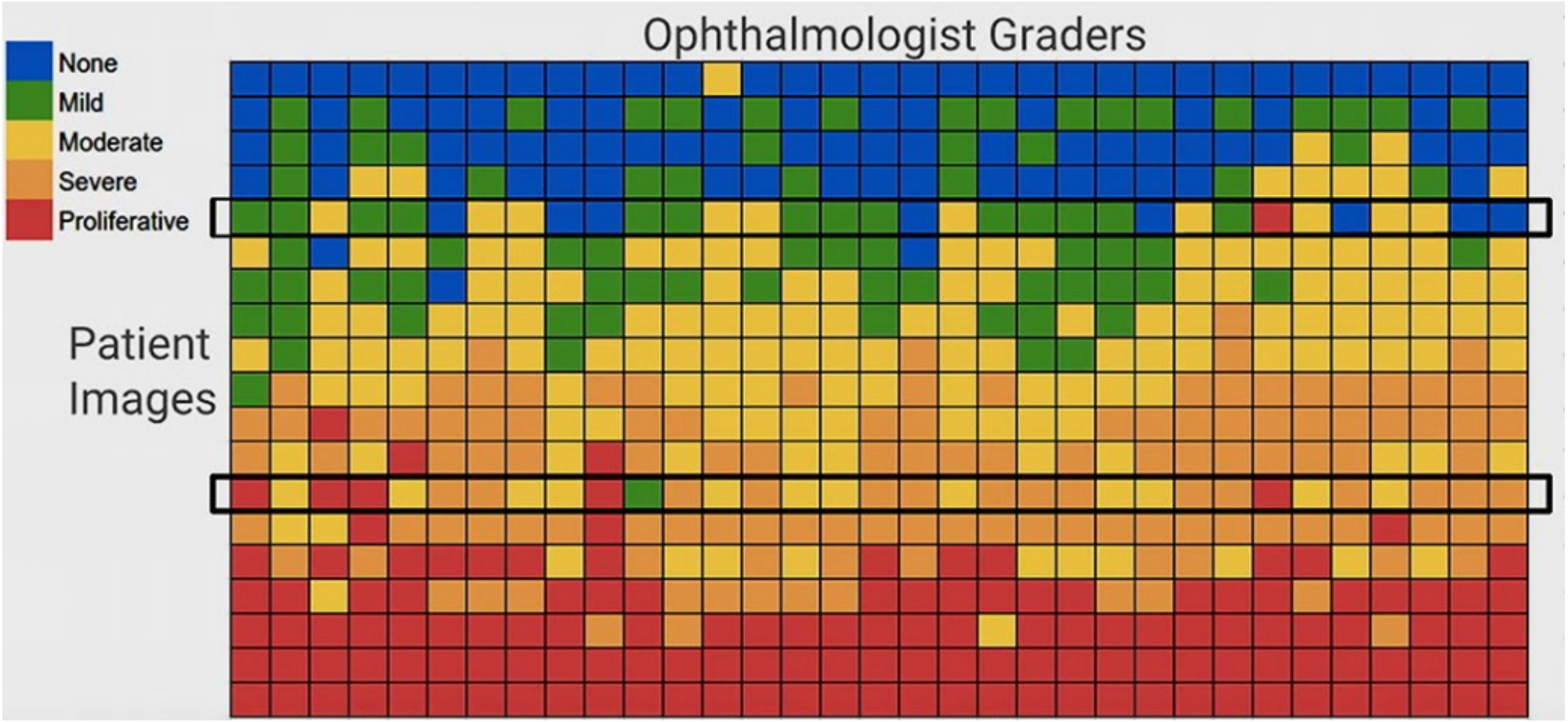
[MESSAGE FROM THE FORUM]

- Crop eye like circle
- Subtract local mean to amplify patterns



0.731 → 0.732 LB, we’re making progress

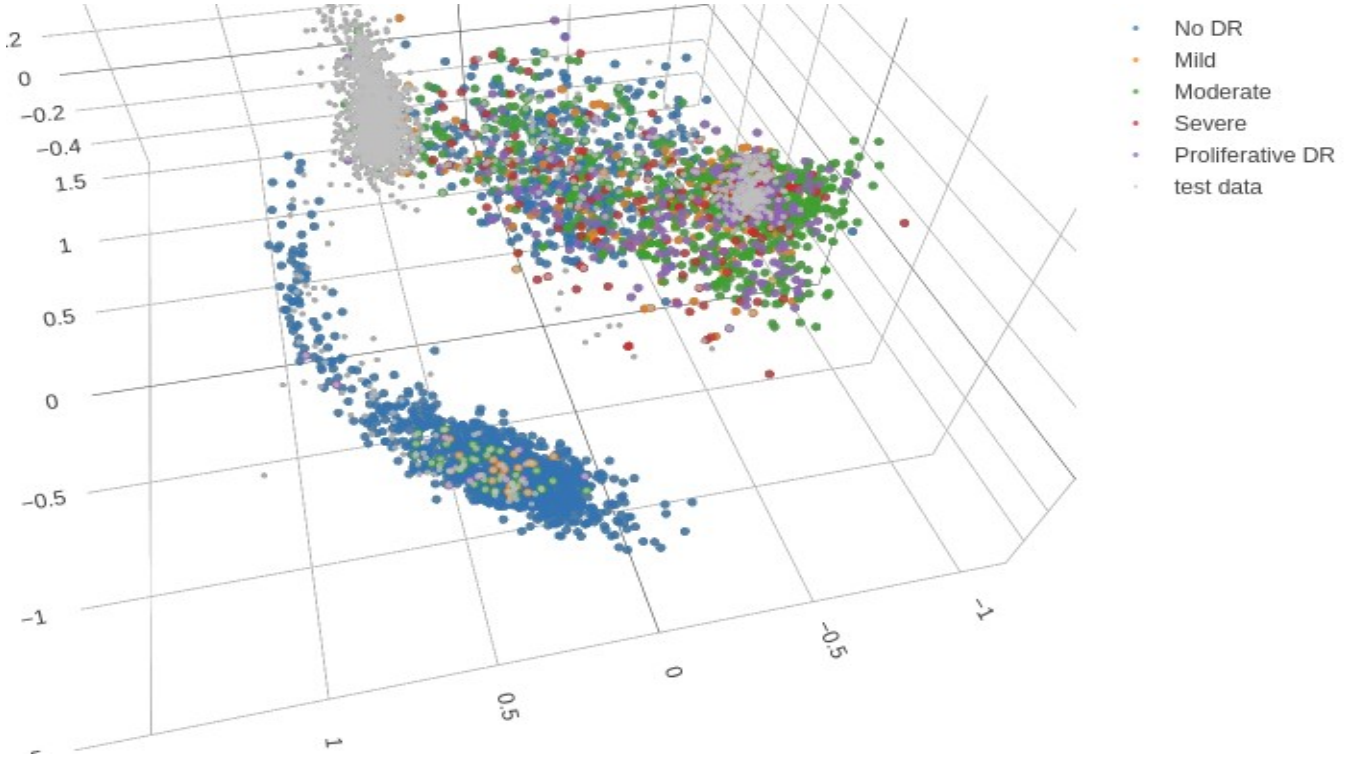
Houston, we have a problem…



They disagree with each other 65% of times!

Source: bit.ly/2kt0tz5

Oops, another problem



Train and public data separate with quite well

Stages of disease separate really bad

Use bigger model: SE ResNeXt50 0.732 → 0.751 LB

Source: bit.ly/2lQUjcf

Ordinal regression task

Neural network works out of the box!
Add sigmoid outputs and sum them

$$y = \begin{cases} 1 \text{ if } y^* \leq \theta_1, \\ 2 \text{ if } \theta_1 < y^* \leq \theta_2, \\ 3 \text{ if } \theta_2 < y^* \leq \theta_3 \\ \vdots \\ K \text{ if } \theta_{K-1} < y^*. \end{cases}$$

Targets for 5 classes:

0 = [0, 0, 0, 0]
1 = [1, 0, 0, 0]
2 = [1, 1, 0, 0]
3 = [1, 1, 1, 0]
4 = [1, 1, 1, 1]

0.751 → 0.757 LB, kinda better

Regression Cerberus

- Classification head
- Regression head
- Ordinal regression head

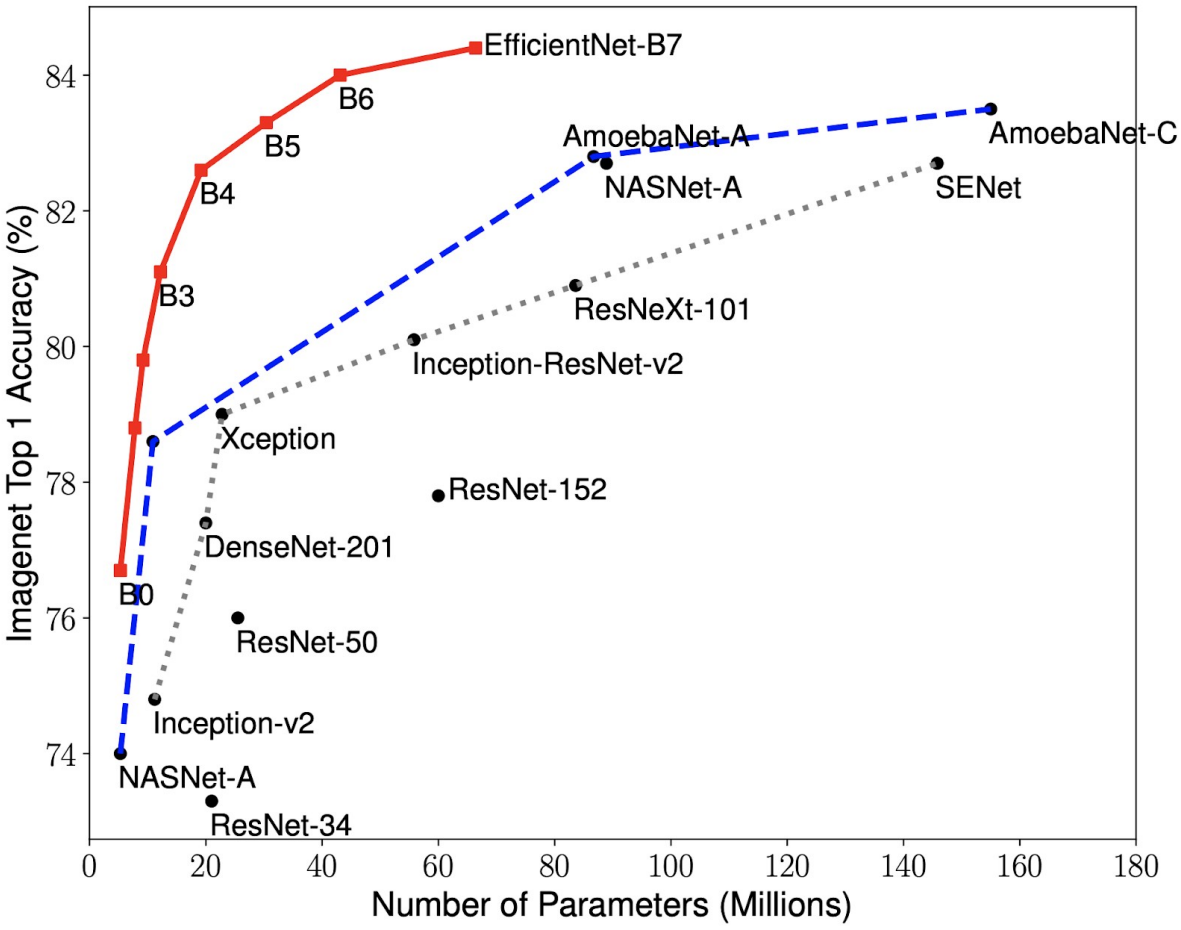
- Average their predictions

0.757 → 0.760 LB, kinda better

Let's go SOTA

- Less parameters
- Less overfitting
- Swish activation

  is **slow**



0.760 → 0.784 LB, woah!

Meet the fabulous EfficientNet!

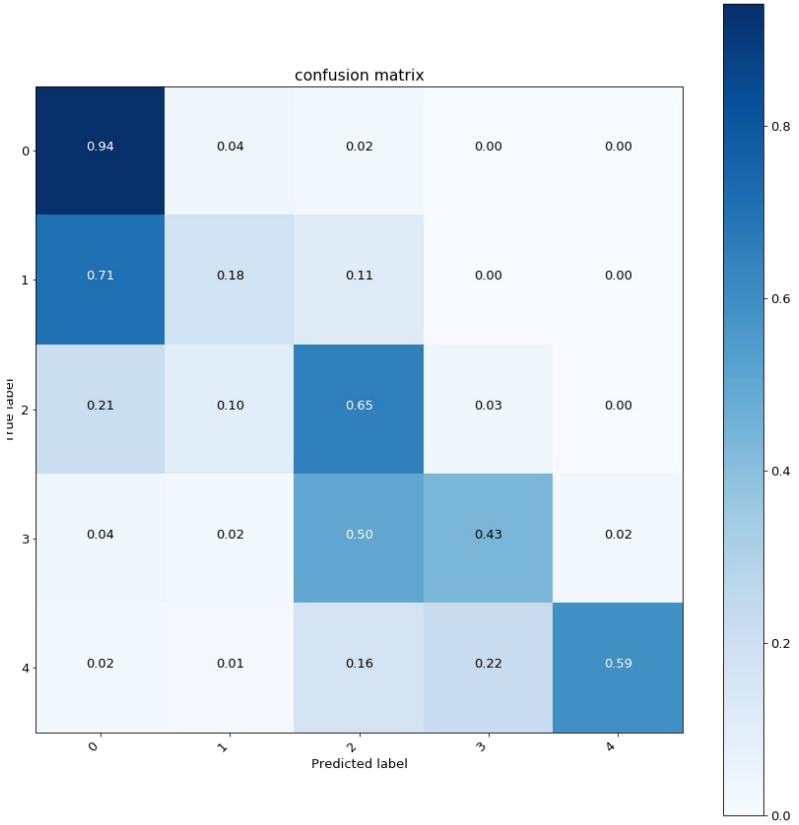
We need more data!

- Previous competition: 35126 photos
- MESSIDOR: 1748 photos
- IDRID: 516 photos

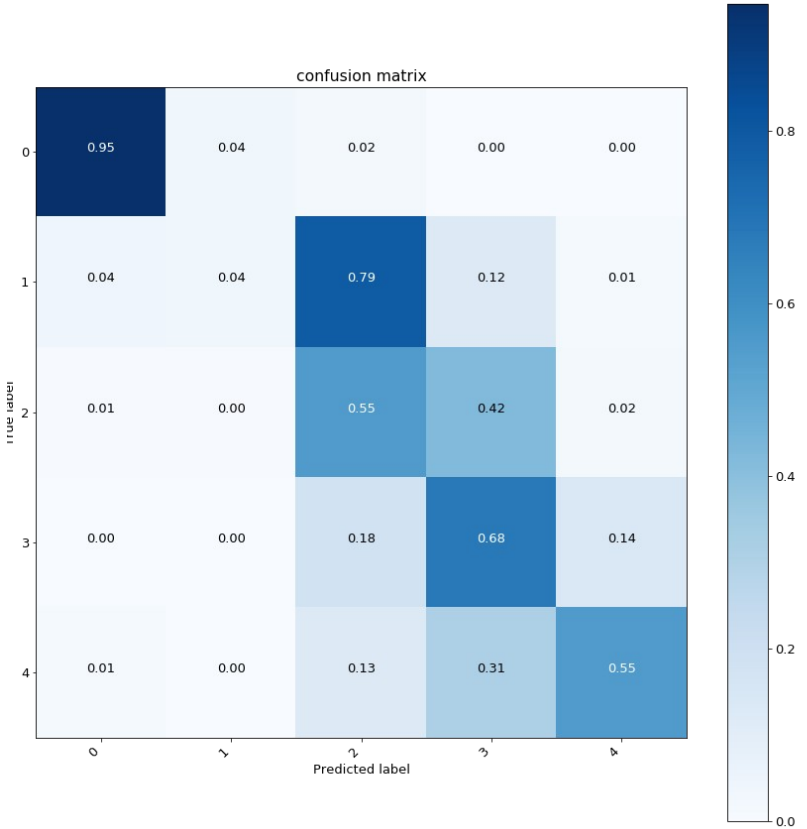
37390 photos total

We need more hardware! 

Data from 2015 looks not so good



Train confusion matrix



Validation confusion matrix

Train on 2015 data, validate on 2019 data


DIFFERENT GRADING
I WILL NEVER USE THIS DATA
PUBLIC KERNEL IS STILL BETTER
AMERICANS DIFFER FROM INDIANS
SOMETHING WRONG
DIFFERENT FEATURES
GOLD IS SO FAR AWAY
I MADE A MISTAKE
risovach.ru

Alter training procedure

- Pretrain whole network on 2015 data, IDRID and MESSIDOR
- Throw out head
- Take away holdout set of 2019 data
- 5-fold CV on 2019 data
- Choose by MSE on holdout set

0.784 → 0.797, promising

First 0.8 LB here!

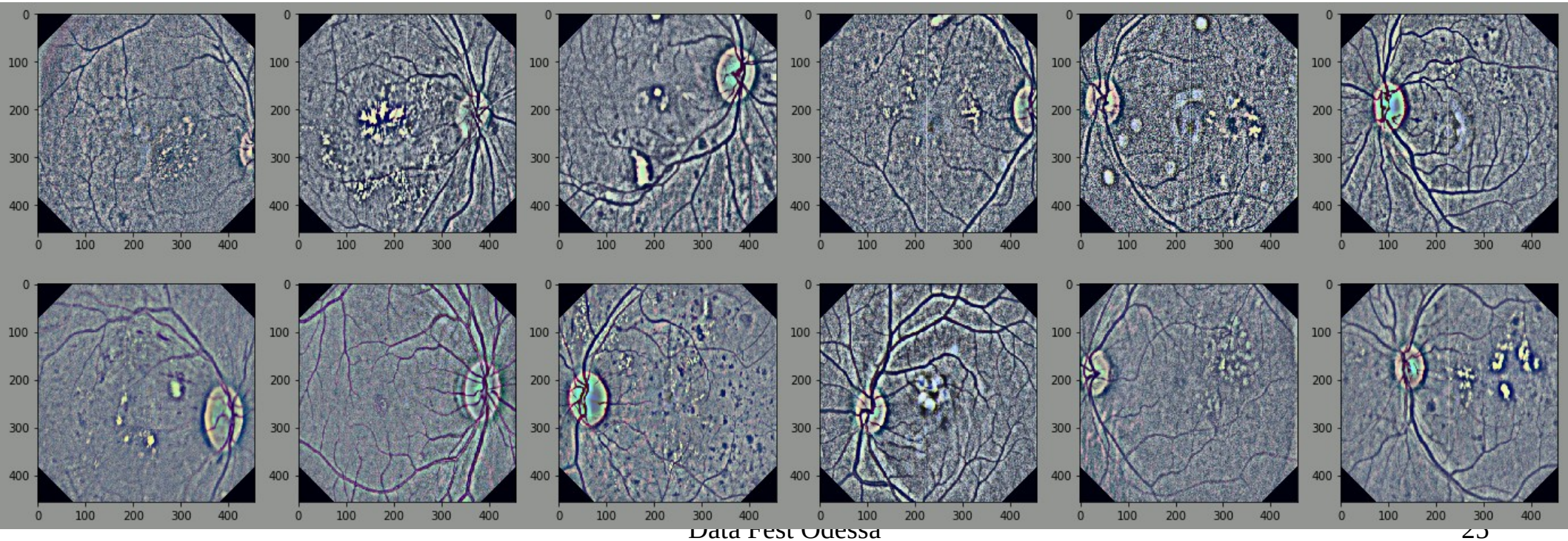
[MESSAGE FROM THE FORUM]

Neural network can deduce image shape even with preprocessing

Crop center portion of the eye

Mask corners

Subtract mean to reduce color influence



Did no good… consistently on all models

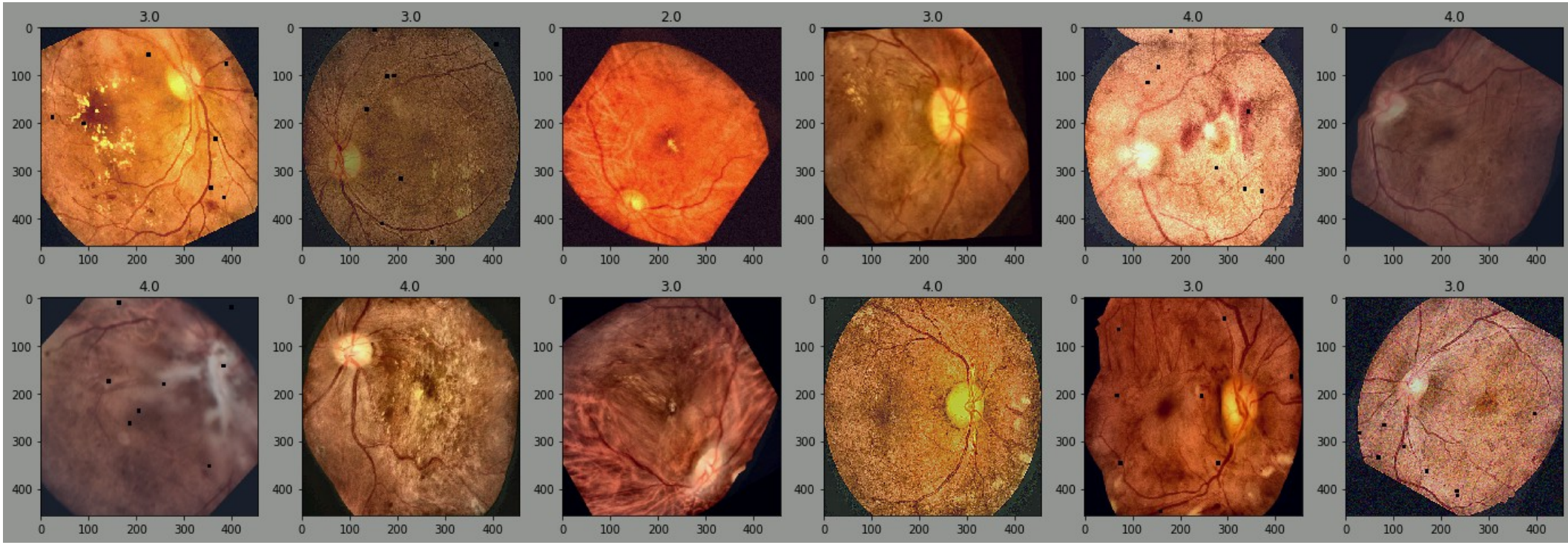
Alter training procedure (again)

- Pretrain whole network on 2015 data
- Throw out head
- Take away holdout set of 2019 data
- 5-fold CV on 2019 data IDRID and MESSIDOR
- Choose by MSE on holdout set

0.797 → 0.804, like it

First 0.8 LB here!

Hmm, maybe we lose information with preprocessing?



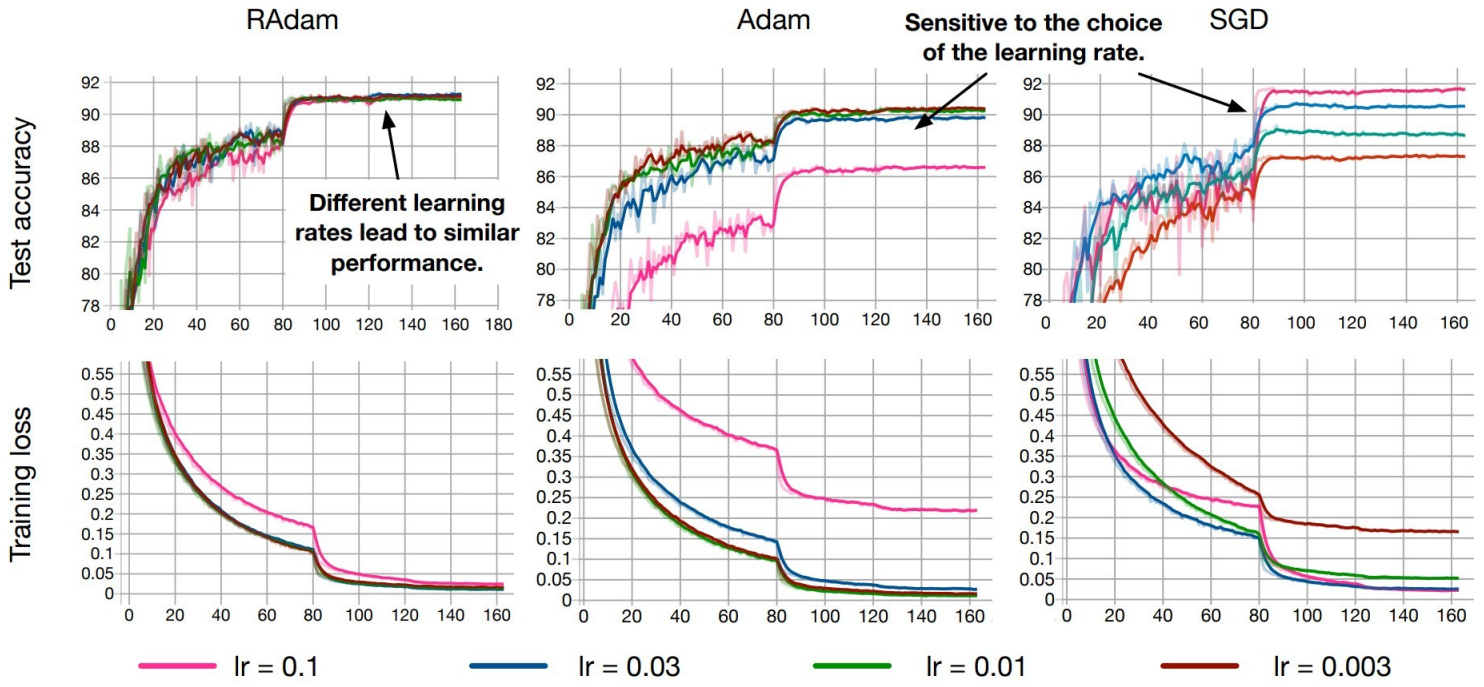
No preprocessing!

Augment like hell!

0.804 → 0.812

Optimizer matters!

- Started with SGD+Nesterov+CosineLR
- Swithced to RAdam+CosineLR

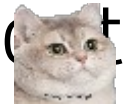


0.812 → 0.825

New panacea in deep learning?

Ensembling

- Take best models (CV and LB)
- Average their raw predictions
- Discretize to 0...4 labels

- Better on holdout 
- Worse on LB

Our best performing models

- EfficientNet-B4
- EfficientNet-B5
- SEResNeXt50
- DenseNet169

Summary

- No need of fancy things to get decent results
- Devil is in the details
- You can’t trust nor your CV nor LB
- Waiting for shakeup 

- Ask me about results tomorrow


THE
SHAKEUP
IS
NEAR

Thanks for your attention!

ods.ai: spsancti

fb.com/borys.tymc

t.me/spsancti