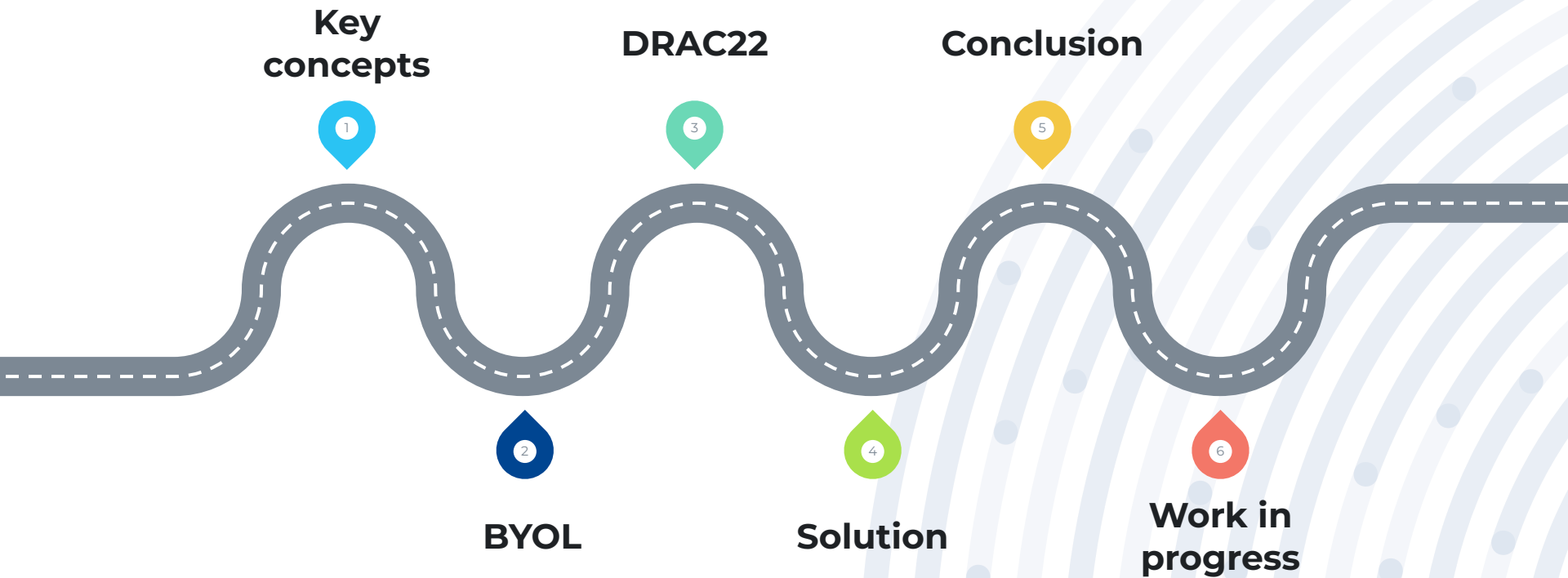


# BYOL

Bootstrap Your Own Latent  
A New Approach to Self-Supervised Learning

Temirlan Turysbek

# Roadmap





# 1. **Key concepts**

# Key concepts:

“a new approach to self-supervised image **representation learning**”



$\begin{bmatrix} 0, \\ -2, \\ 0.5 \end{bmatrix}$   
...

**parrot**

A large, colorful, circular collage of many small, unlabeled images arranged in a spiral pattern, creating a tunnel-like effect. The images are diverse, showing various subjects like people, animals, landscapes, and objects. The text "lots of unlabelled data" is centered over the collage.

**lots of unlabelled data**

# Key concepts:

“a new approach to **self-supervised** image representation learning”

neural network learns in two steps:

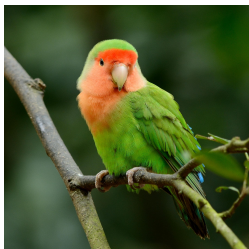
- unsupervised pseudo-labelling to initialize weights
- solving the actual downstream task



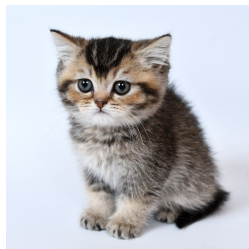
# Key concepts:

“a new approach to **self-supervised** image representation learning”

## Contrastive SSL (SimCLR)



positive  
example



negative  
example

## Non-contrastive SSL



positive  
example



positive  
example

## 2. BYOL





# why BYOL is better?

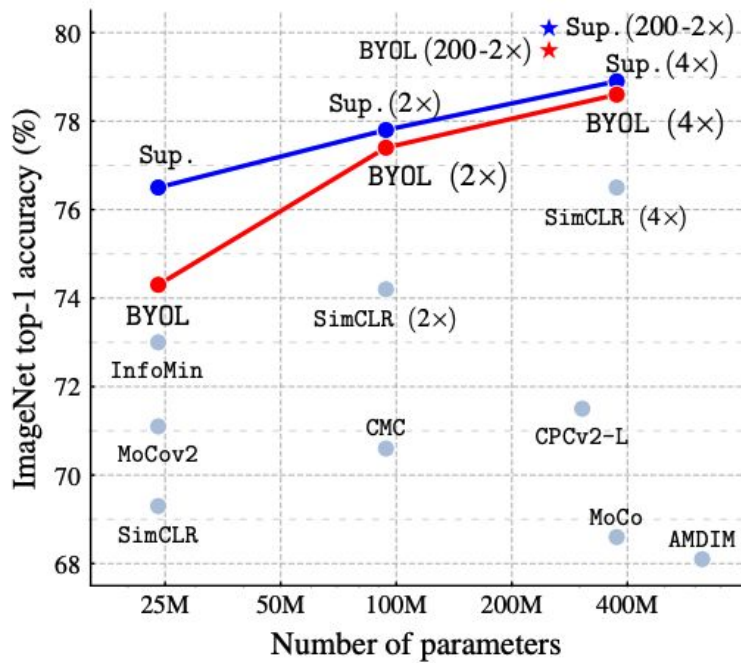


Figure: performance of BYOL

- performs better than state-of-the-art model (SimCLR)
- doesn't use negative pairs
- avoids collapsed representations by stop\_gradient

# why BYOL is better?

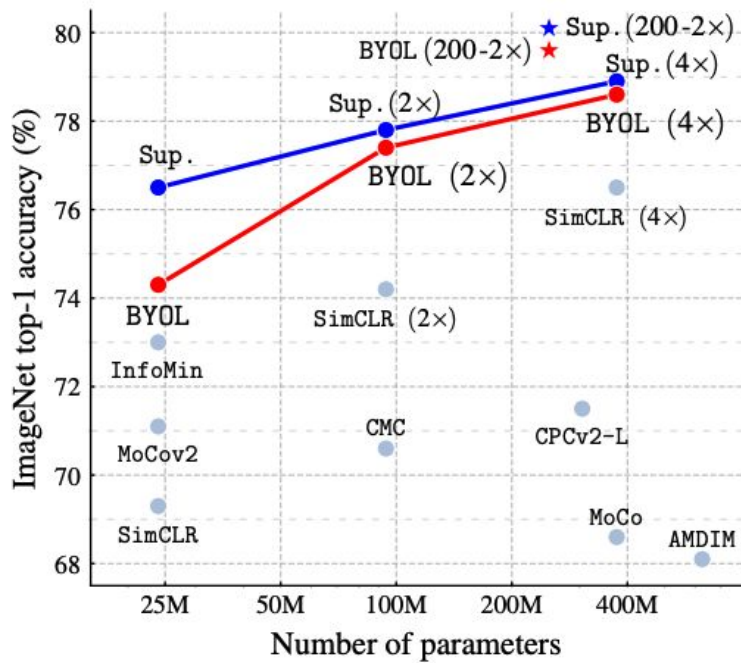
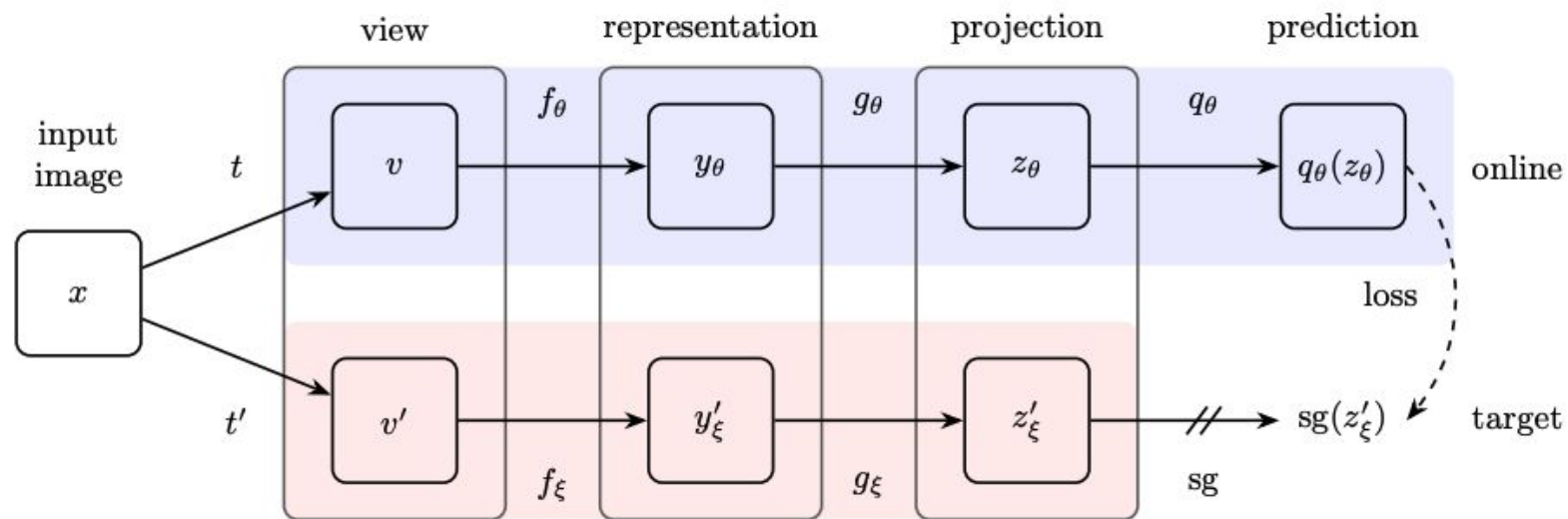


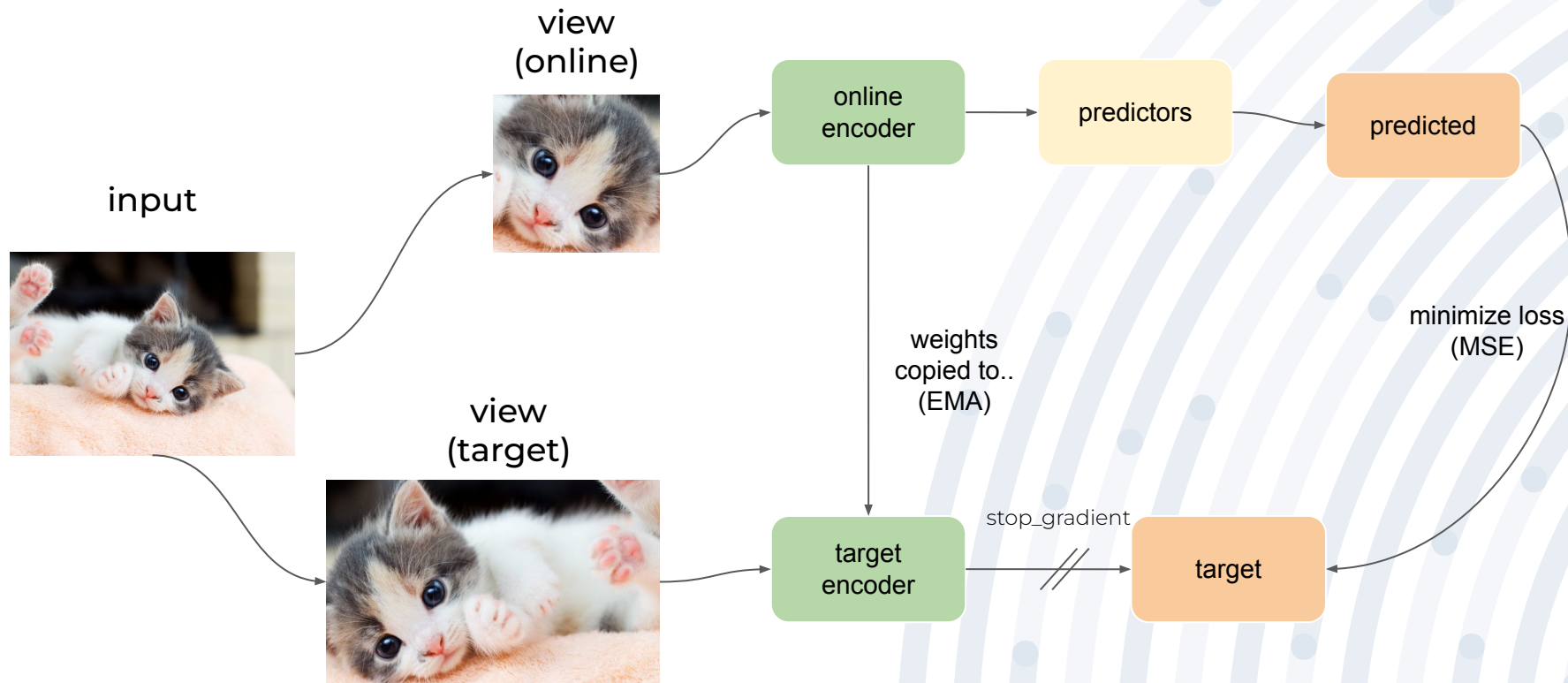
Figure: performance of BYOL

- performs better than state-of-the-art model (SimCLR)
  - doesn't use negative pairs
  - avoids collapsed representations by stop\_gradient
- and also:
- more robust to view augmentations
  - more stable for low batch sizes

# Architecture



# Cute architecture



# 3. DRAC22

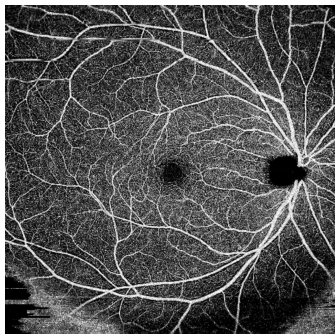


# Diabetic Retinopathy Analysis Challenge

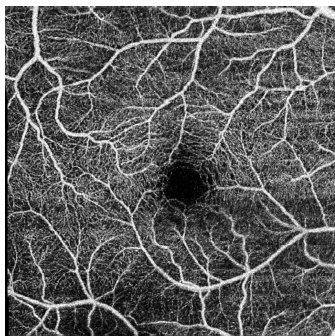
- Task 1: Segmentation of Diabetic Retinopathy Lesions
- Task 2: Image Quality Assessment
- Task 3: Diabetic Retinopathy Grading



# DRAC dataset



(1024, 1024)



tasks statistics

	Training samples	# classes
Task 2	<b>665</b>	<b>3</b>
Task 3	<b>611</b>	<b>3</b>

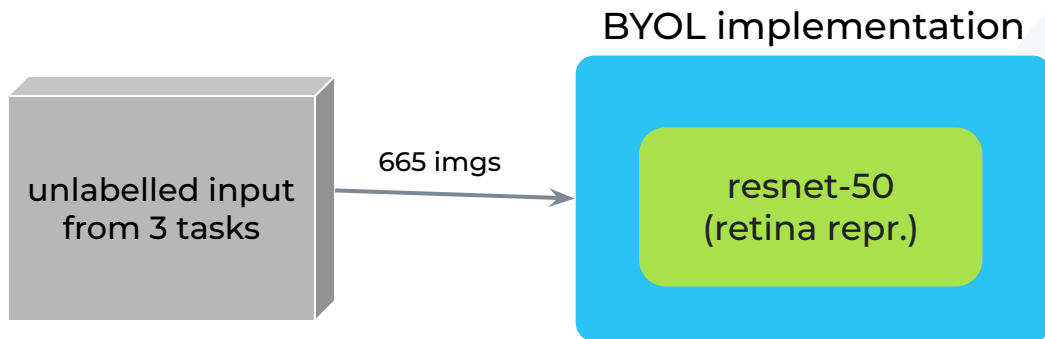
tasks 3 statistics

	# samples
Class 0	<b>328</b>
Class 1	<b>213</b>
class 2	<b>70</b>

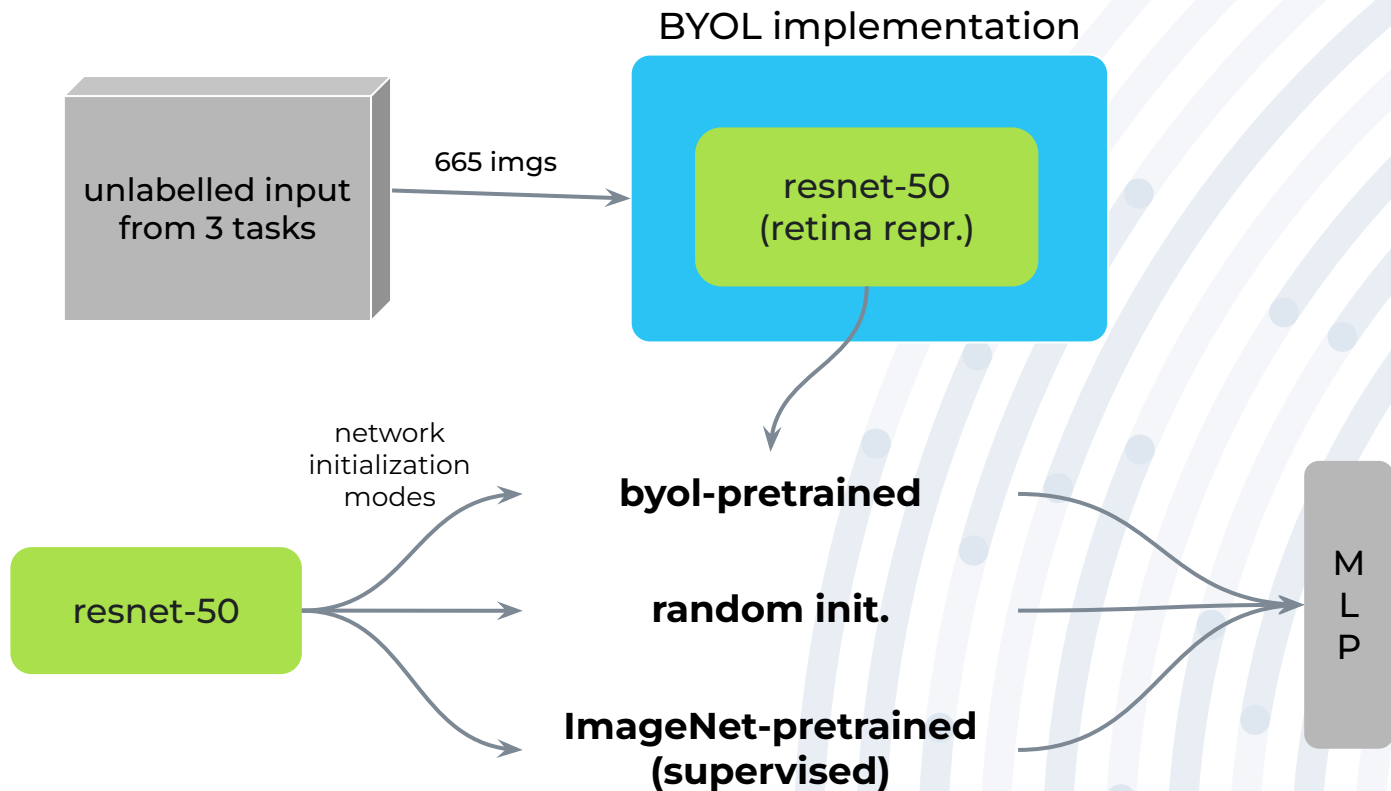
# 4. Solution



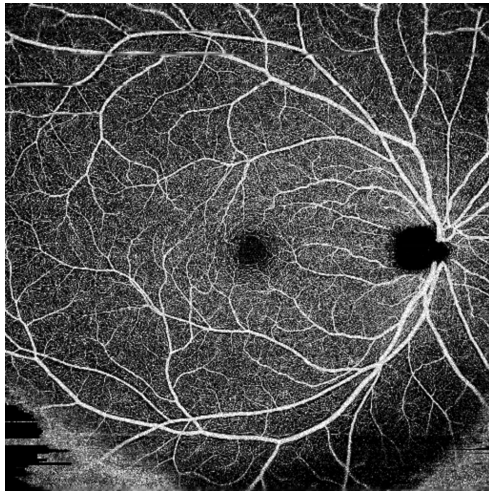
# My Approach



# My Approach



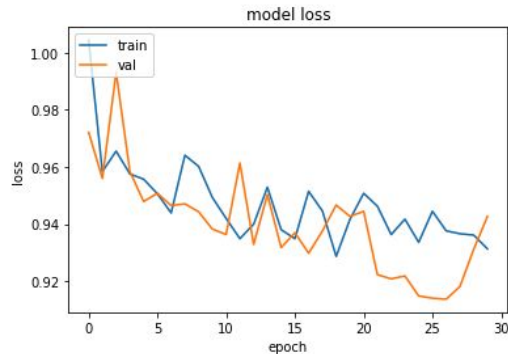
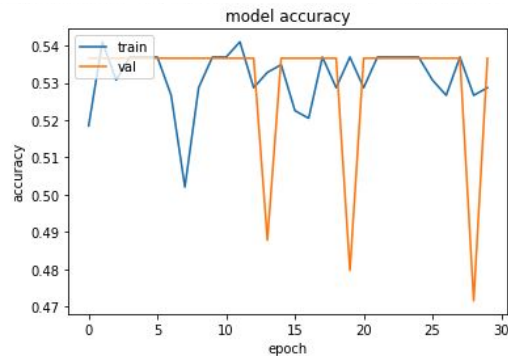
# My Approach



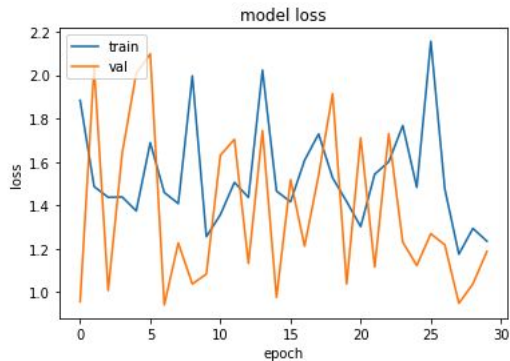
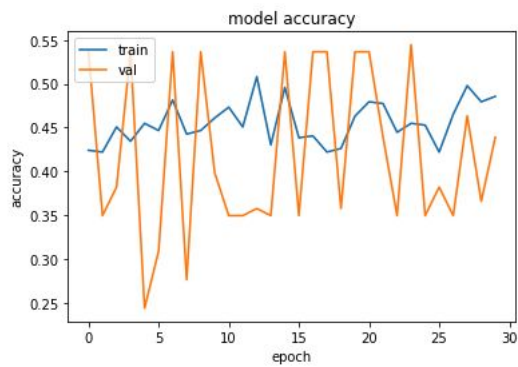
(1024, 1024) -> (512, 512) -> convert('RGB') -> BATCH\_SIZE=8

# Results

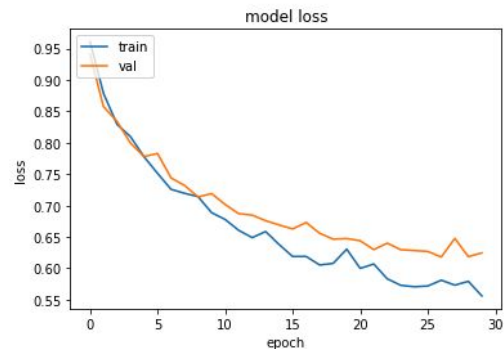
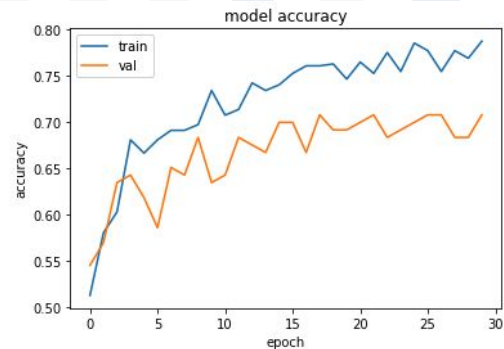
## BYOL-pretrained



## random-init



## ImageNet-pretrained

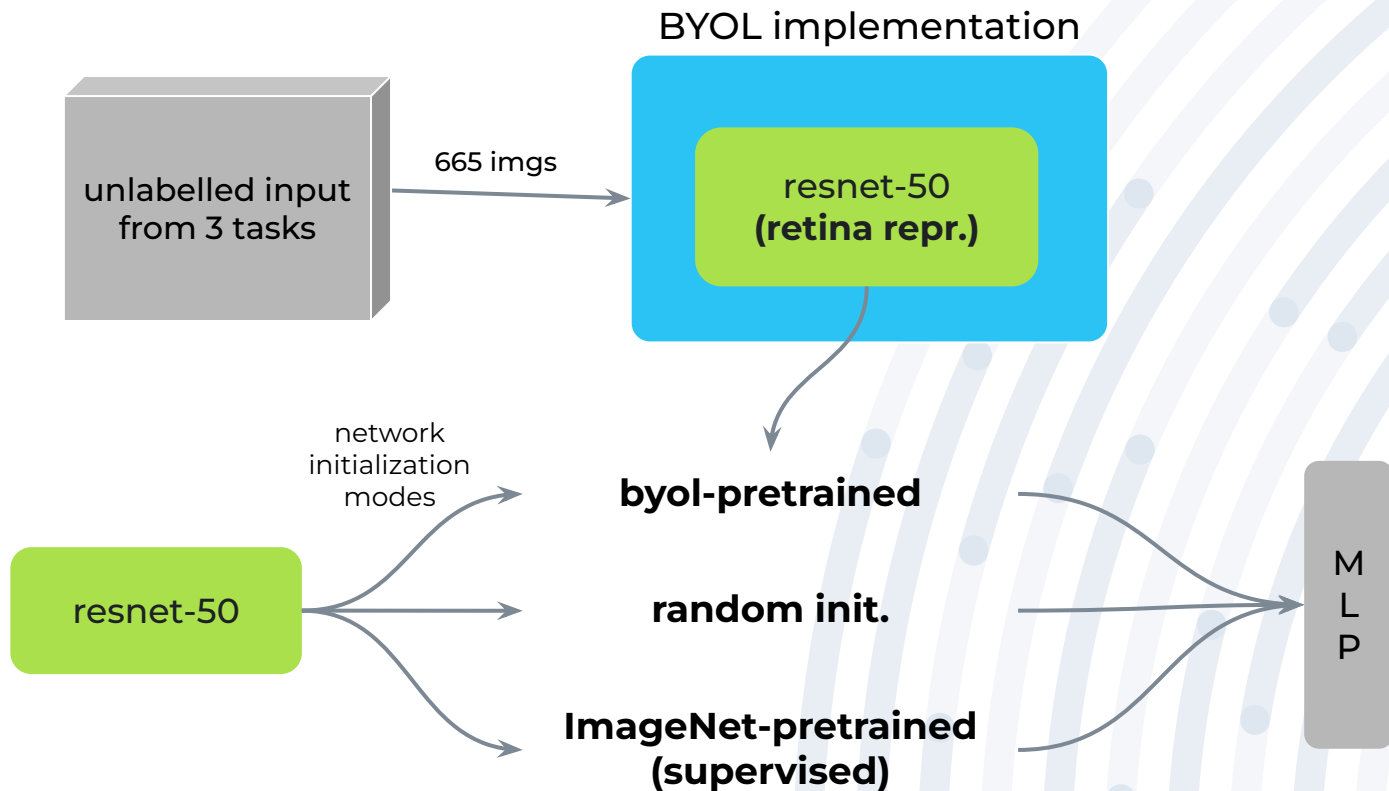




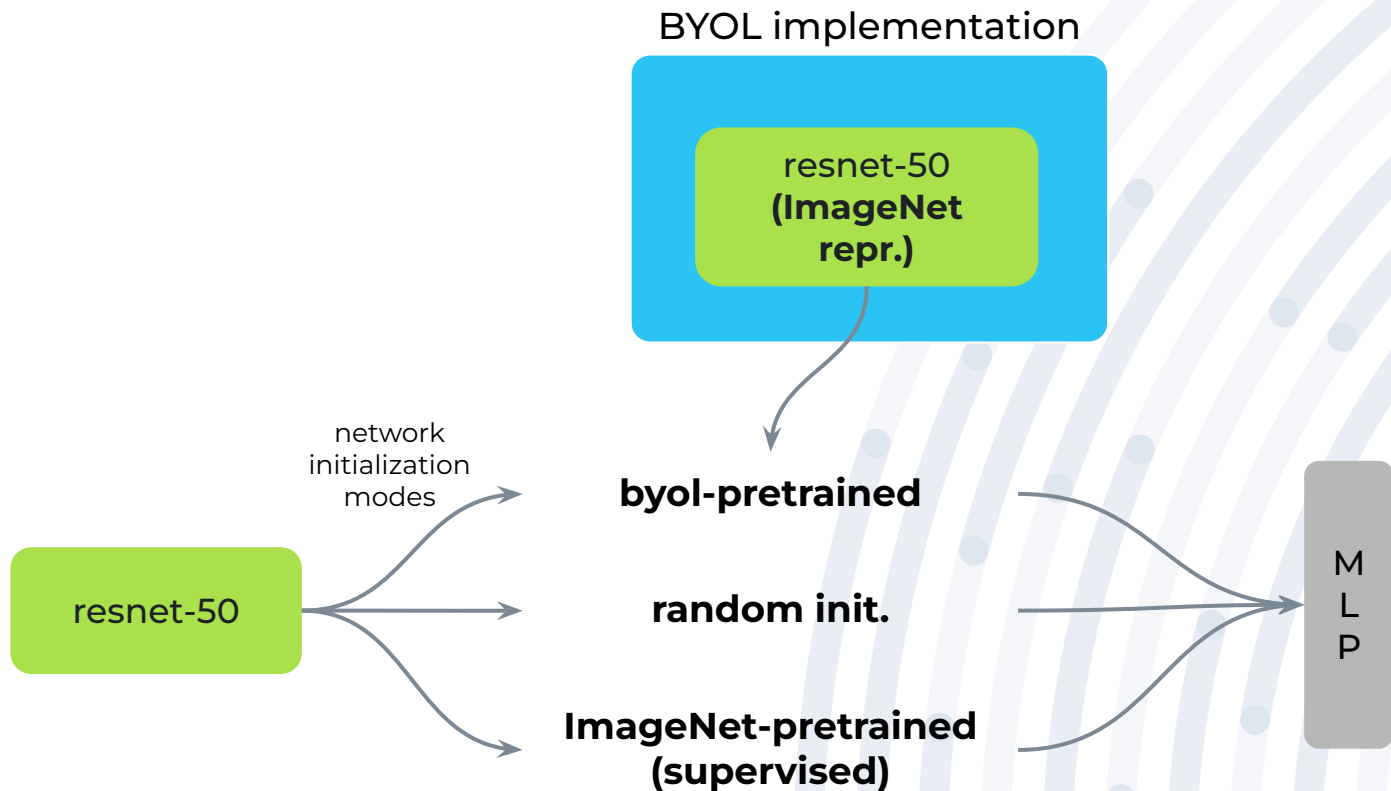
# Results

# ↑	User (Team)	↕ Created	↕ Quadratic Weighted Kappa
1st	 kwongitack (FAI)	10 Aug. 2022	0.8158
2nd	 justin.engelmann@ed.ac.uk  (MINT Brewery)	10 Aug. 2022	0.8048
3rd	 arapodcho (KT Bio Health)	11 Aug. 2022	0.8038
4th	 YuboTan (noodles)	10 Aug. 2022	0.7018
5th	 hrishikeshps94  (Team_SCF)	9 Aug. 2022	0.6883
6th	 Riccc	11 Aug. 2022	0.6749
7th	 actingwizard 	11 Aug. 2022	0.3342
8th	 Balamurali  (DiagnosETS)	10 Aug. 2022	0.1654

# What else?

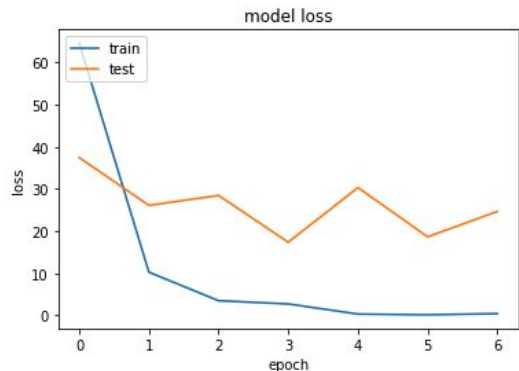
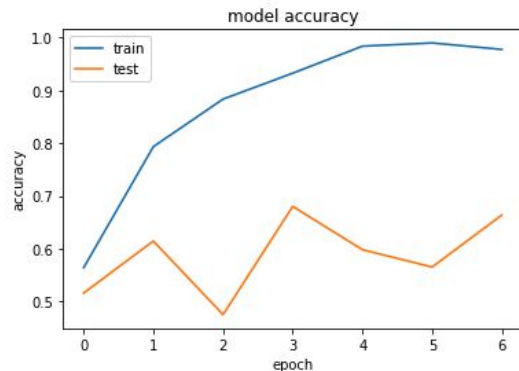


# What else?



# Results

```
Epoch 1/10
31/31 [====- ETA: 0s - loss: 64.6040 - acc: 0.5644
Epoch 1: val0.51639, saving model to /content/drive/MyDrive/BYOL/C. Diabetic Retinopathy Grading
31/31 [====- 110s 3s/step - loss: 64.6040 - acc: 0.5644 - val_loss: 37.4639 - val_acc: 0.5164
Epoch 2/10
31/31 [====- ETA: 0s - loss: 10.2821 - acc: 0.7935
Epoch 2: val0.61475, saving model to /content/drive/MyDrive/BYOL/C. Diabetic Retinopathy Grading
31/31 [====- 75s 2s/step - loss: 10.2821 - acc: 0.7935 - val_loss: 26.1210 - val_acc: 0.6148
Epoch 3/10
31/31 [====- ETA: 0s - loss: 3.5219 - acc: 0.8834
Epoch 3: val0.61475
31/31 [====- 57s 2s/step - loss: 3.5219 - acc: 0.8834 - val_loss: 28.4779 - val_acc: 0.4754
Epoch 4/10
31/31 [====- ETA: 0s - loss: 2.7538 - acc: 0.9325
Epoch 4: val0.68033, saving model to /content/drive/MyDrive/BYOL/C. Diabetic Retinopathy Grading
31/31 [====- 87s 3s/step - loss: 2.7538 - acc: 0.9325 - val_loss: 17.3893 - val_acc: 0.6803
Epoch 5/10
31/31 [====- ETA: 0s - loss: 0.3543 - acc: 0.9836
Epoch 5: val0.68033
31/31 [====- 61s 2s/step - loss: 0.3543 - acc: 0.9836 - val_loss: 30.3389 - val_acc: 0.5984
Epoch 6/10
31/31 [====- ETA: 0s - loss: 0.1854 - acc: 0.9898
Epoch 6: val0.68033
31/31 [====- 55s 2s/step - loss: 0.1854 - acc: 0.9898 - val_loss: 18.6631 - val_acc: 0.5656
Epoch 7/10
31/31 [====- ETA: 0s - loss: 0.4610 - acc: 0.9775
Epoch 7: val0.68033
31/31 [====- 57s 2s/step - loss: 0.4610 - acc: 0.9775 - val_loss: 24.6816 - val_acc: 0.6639
```



# 5. Conclusion



# Conclusion

- BYOL - interesting, novel idea for semi-supervised representation learning task
- However, its benefits in other domains should be verified



# Conclusion

- BYOL - interesting, novel idea for semi-supervised representation learning task
- However, its benefits in other domains should be verified

## Work in progress

- increase MLP complexity
- use lower level embeddings e.g 48th layer from resnet50 (ImageNet-pretrained)
- check relevant data augmentations to DRAC domain
- increase projection layer's size in BYOL



**Temirlan Turysbek**  
**MSc. in Data Science @ LMU**  
**[temirlan.turysbek@campus.lmu.de](mailto:temirlan.turysbek@campus.lmu.de)**

# References

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- [https://en.wikipedia.org/wiki/Self-supervised\\_learning](https://en.wikipedia.org/wiki/Self-supervised_learning)
- [https://pytorch.org/tutorials/beginner/transfer\\_learning\\_tutorial.html#train-and-evaluate](https://pytorch.org/tutorials/beginner/transfer_learning_tutorial.html#train-and-evaluate)
- <https://github.com/lucidrains/byol-pytorch>
- <https://drac22.grand-challenge.org/>
- <https://medium.com/@kenneth.ca95/a-guide-to-transfer-learning-with-keras-using-resnet50-a81a4a28084b>