Test Time Augmentation

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What is TTA?

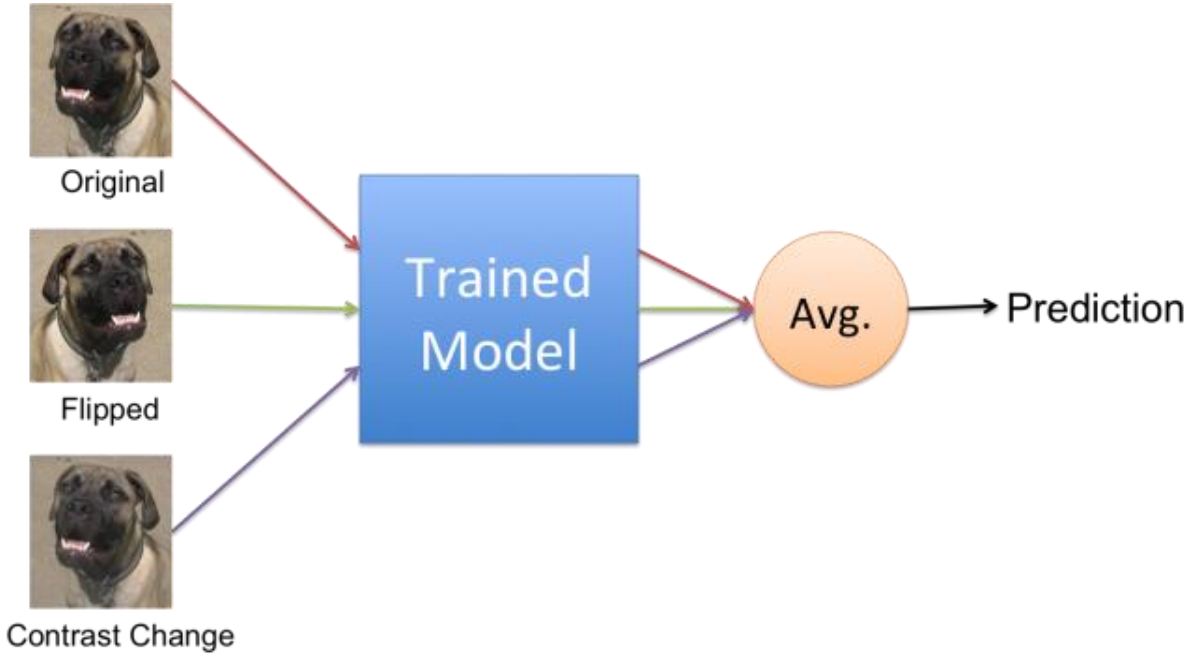
❖ TTA Abstract

- A method of augmentation when testing a model.
- No need to change the trained model(applicable to pretrained models)
- A kind of data ensemble

What is TTA

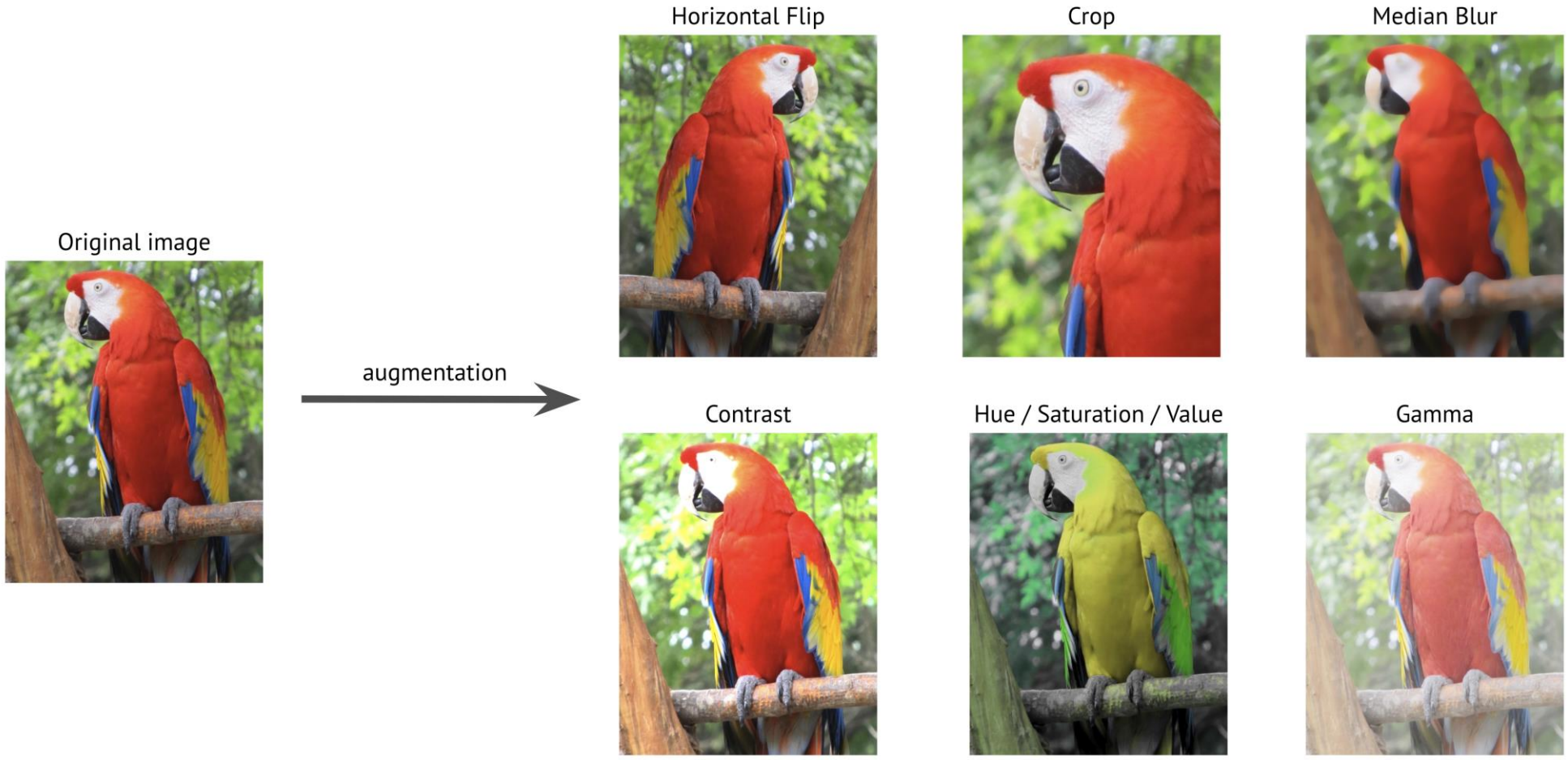
❖ TTA Example

- Make 2 augmentation image from 1 origin image
- Each image put in trained model and prediction.
- Aggregate each prediction and make final prediction.



TTA Method

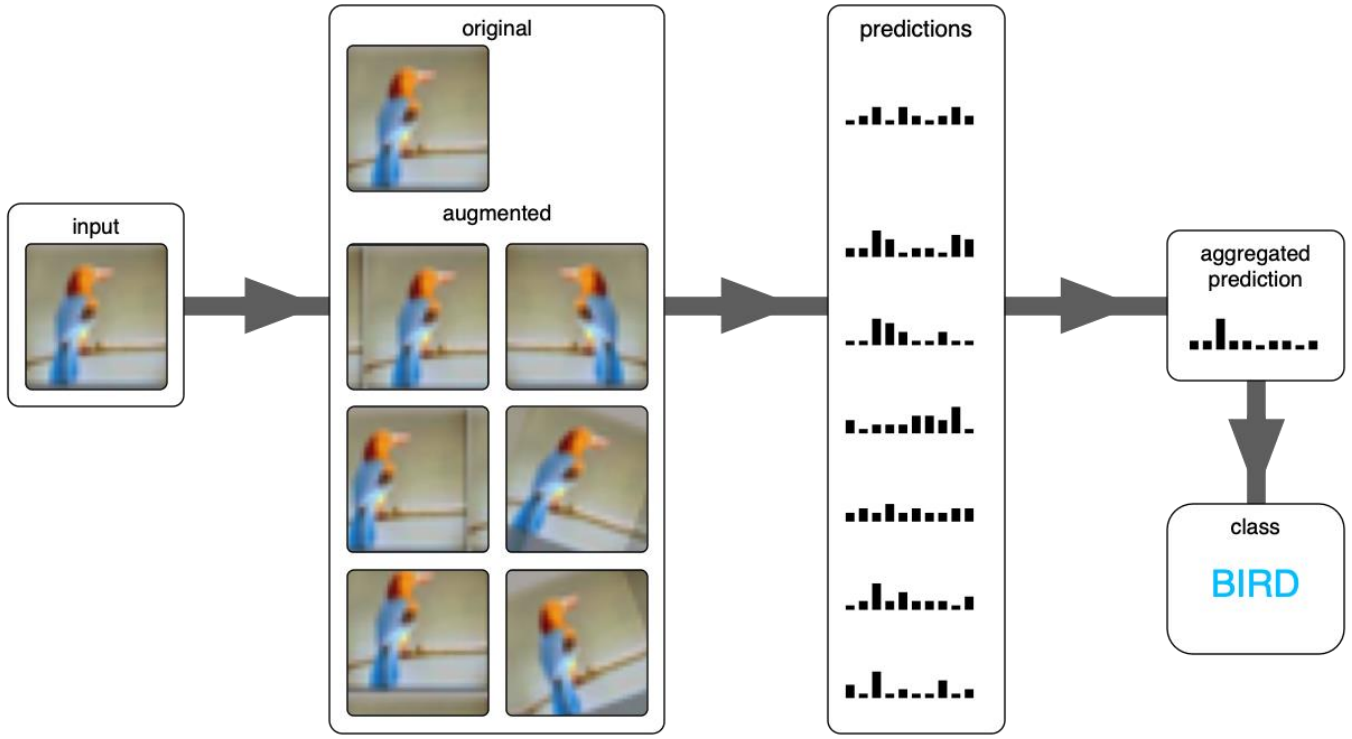
❖ Augmentation method



TTA in Image Classification

❖ Method

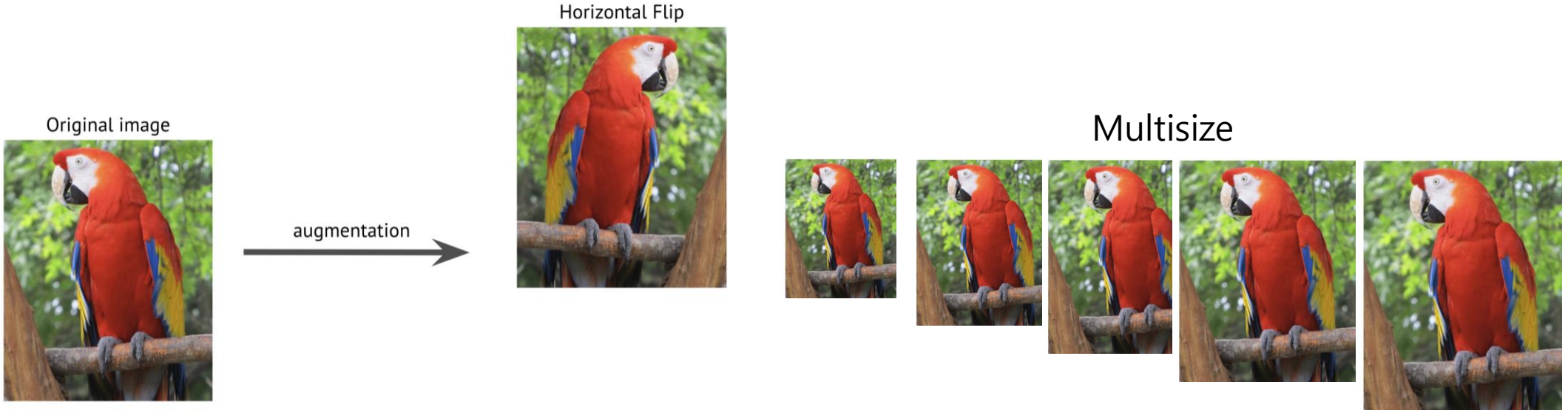
- **flip, crop, scale, rotate, shift**



TTA in Object Detection

❖ Method

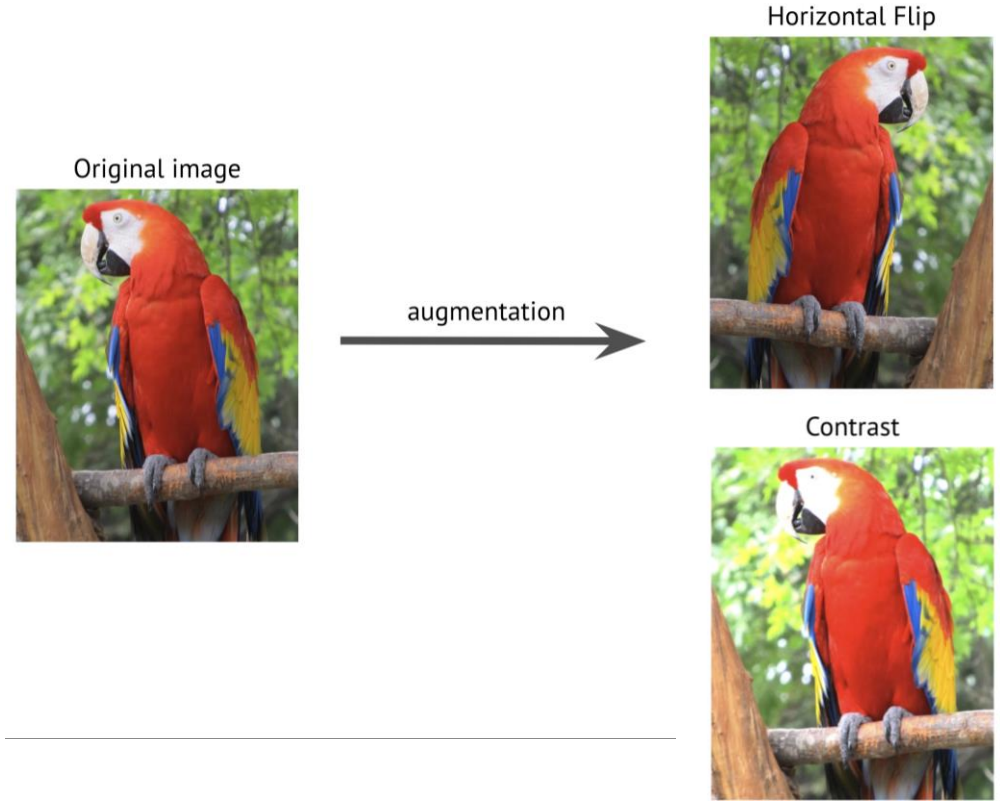
- In Object detection, **HorizontalFlip** and **Multisize** augmentation are usually used.



TTA in Object Detection

❖ Method

- I add **contrast** augmentation for my experiments.



Experiments

❖ Baseline

- Use Detectron2 Faster R-CNN FPN 50

Name	lr sched	train time (s/iter)	inference time (s/im)	train mem (GB)	box AP	model id	download
R50-C4	1x	0.551	0.102	4.8	35.7	137257644	model | metrics
R50-DC5	1x	0.380	0.068	5.0	37.3	137847829	model | metrics
R50-FPN	1x	0.210	0.038	3.0	37.9	137257794	model | metrics
R50-C4	3x	0.543	0.104	4.8	38.4	137849393	model | metrics
R50-DC5	3x	0.378	0.070	5.0	39.0	137849425	model | metrics
R50-FPN	3x	0.209	0.038	3.0	40.2	137849458	model | metrics
R101-C4	3x	0.619	0.139	5.9	41.1	138204752	model | metrics
R101-DC5	3x	0.452	0.086	6.1	40.6	138204841	model | metrics
R101-FPN	3x	0.286	0.051	4.1	42.0	137851257	model | metrics
X101-FPN	3x	0.638	0.098	6.7	43.0	139173657	model | metrics

Experiments

방법	AP	Input 이미지 수
Baseline	**40.2161**	**1**
Horizontal flip	39.9611	2
multi scale [400]	34.0913	2
multi scale [400, 600]	38.7303	3
multi scale [400, 600, 800]	40.7866	4
multi scale [400, 600, 800, 1000]	41.5094	5
contrast [0.95, 1.05]	40.129	2
contrast [0.9, 1.1]	40.2049	2
horizontal flip + contrast [0.9, 1.1]	40.613	3
horizontal flip + multi scale [400]	40.4806	4
horizontal flip + multi scale [400, 600]	40.7663	6
horizontal flip + multi scale [400, 600, 800]	41.1275	8
horizontal flip + multi scale [400, 600, 800, 1000]	**41.6996**	**10**
horizontal flip + contrast [0.9, 1.1] + multi scale [400, 600, 800, 1000]	41.67	15

Gain

❖ Multisize

- As the number of input images increases, AP is increase.(size of image must difference each other)
- It's most effective way to improve AP when apply one augmentation method

Gain

❖ Horizontal flip

- Use Horizontal flip only, not good result in AP
- Results AP is lower than baseline.

Gain

❖ Contrast

- Use Contrast only, not good result in AP
- Results AP is lower than baseline.

Gain

❖ Contrast

- Use Contrast only, not good result in AP
- Results AP is lower than baseline.

Gain

❖ Combination

- Multisize with horizontal flip augmentation is best result in my experiments.
- Baseline is **40.2161**
- horizontal flip + multi scale [400, 600, 800, 1000] is **41.6996**

Problem

❖ Fvcore and argparse

- In case of Detectron2, they use **fvcore** and **argparse** which are manage to configure
- But their mechanism are different each other, so it's to hard to make clean code!
- So instead of use **fvcore,** I just use python class method(use decorator)
- It make singleton pattern for custom configure

Problem

❖ Object detection and Image classification

- There are many methods in Image classification TTA,

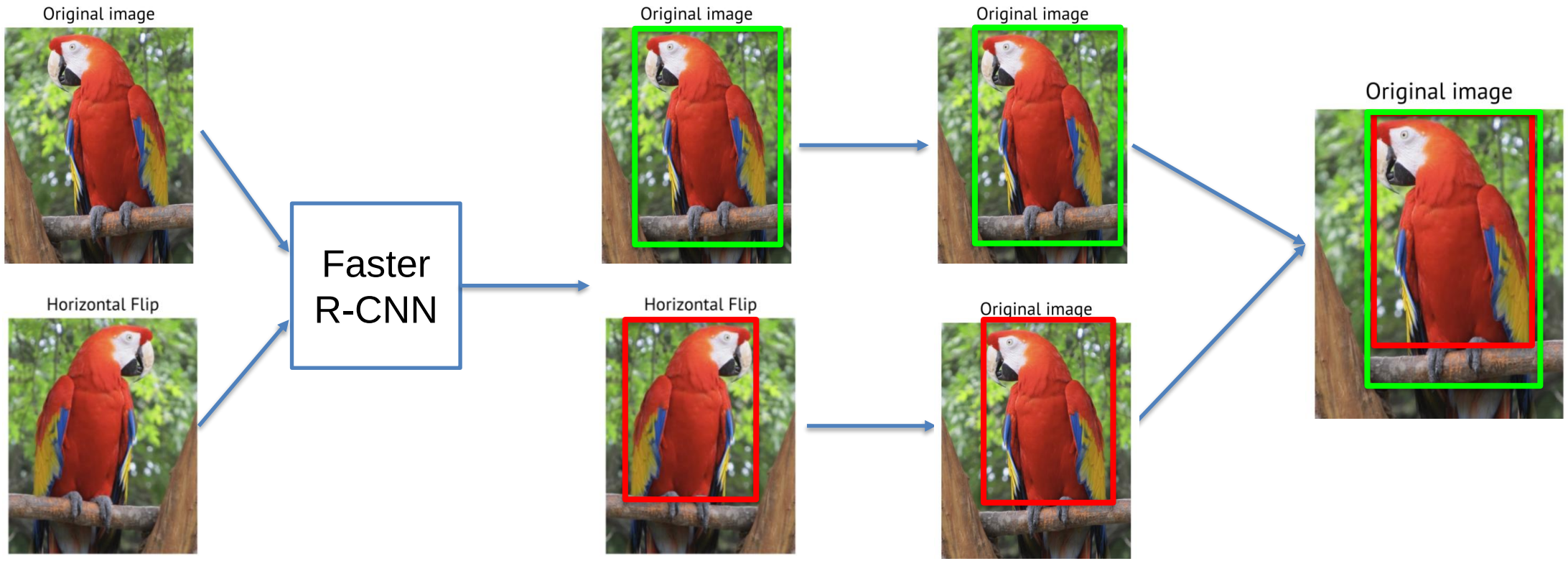
  but there are not many methods in Object detection TTA .

- It was hard to find appropriate method in Object detection TTA

Q & A
감사합니다

Additional Info

- Bbox aggregating in TTA



Additional Info

❖ Score threshold

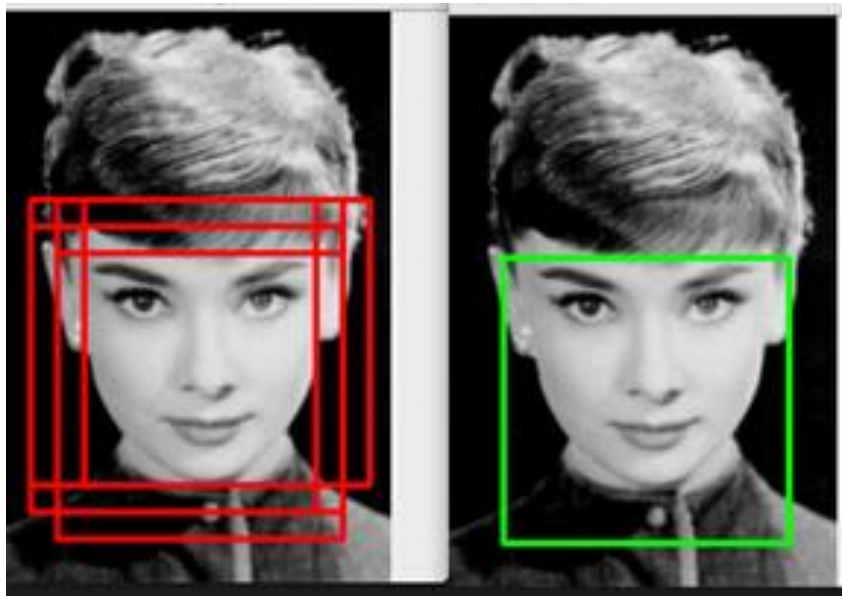
- Faster R-CNN model makes predictions for each bbox
- Predicts a confidence score for each bbox.
- If bbox's score is lower than score threshold, don't use that bbox.

Additional Info

❖ NMS threshold

- NMS is an algorithm that merges overlapping boxes into one.
- When the IOU of each box is greater than the NMS threshold,

  only the box with the highest score is left.



Reference

- https://towardsdatascience.com/test-time-augmentation-tta
- https://stepup.ai/test_time_data_augmentation/
- https://medium.com/pytorch/multi-target-in-albumentations
- pytorch-toolbelt
- detectron2