Mask Up

Face mask detection through deep learning

Intro &
Problem Statement

Ongoing Pandemic

- Control of covid-19 pandemic
- Wearing mask is still the most effective way to inhibit virus transmission

Leverage tech to check for mask wearing compliance

- Use deep learning to allow computers to “see” the world around us
- Manpower could be deployed to help healthcare workers instead

How?

01.

Select Model

1. Single stage object detection model e.g. YOLO (you only look once)
2. Fast inference time, and high accuracy

02.

Collection of Dataset

1. Supervised problem
2. Sufficiently large dataset is required for training

03.

Training Model

1. Train the model so that it has good IoU score

04.

Deployment

1. Deploy trained model on the edge (IoT devices)

Data Collection and Cleaning

Data Collection

- Data available on Kaggle – 848 images and annotation files

Duplicated images

- Using difPy, 5 duplicated images detected and removed (comparing MSE between 2 images)
- Important to remove duplicated imaged as they can cause data leakage

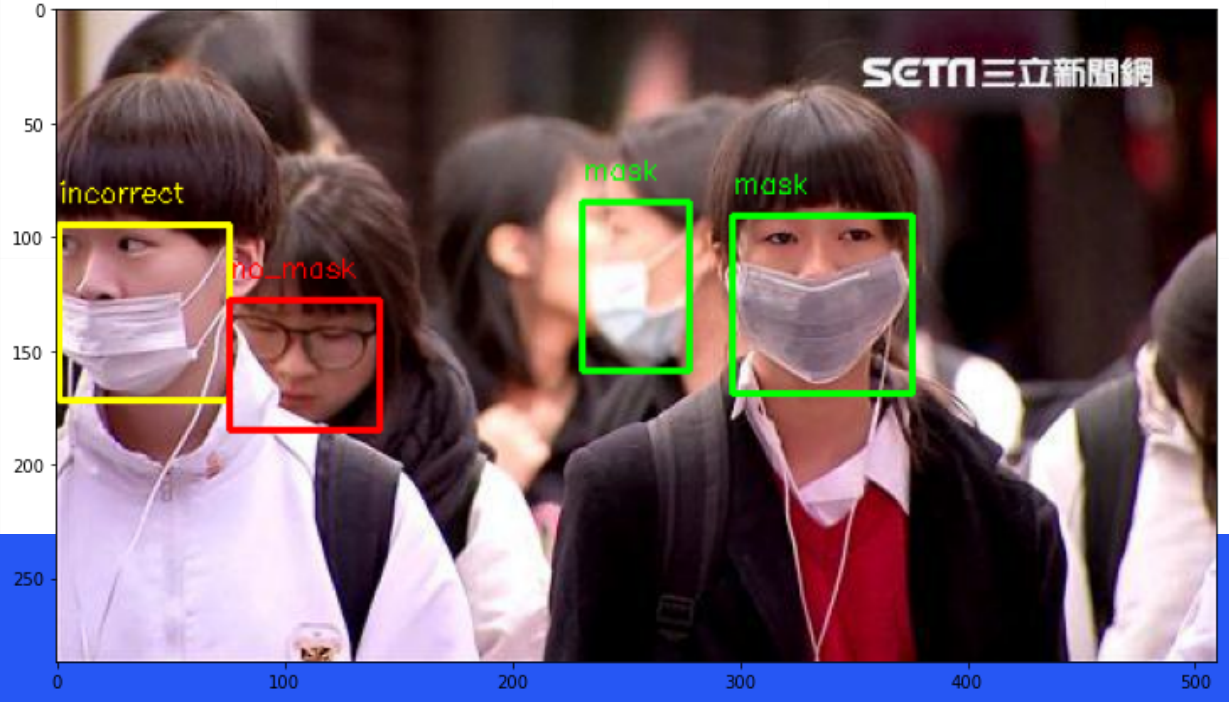
Change class label

- without_mask > no_mask
- with_mask > mask
- mask_weared_incorrect > incorrect

EDA

Check the quality of annotation

- Print out images and annotation information
- Check the bbox and class



EDA

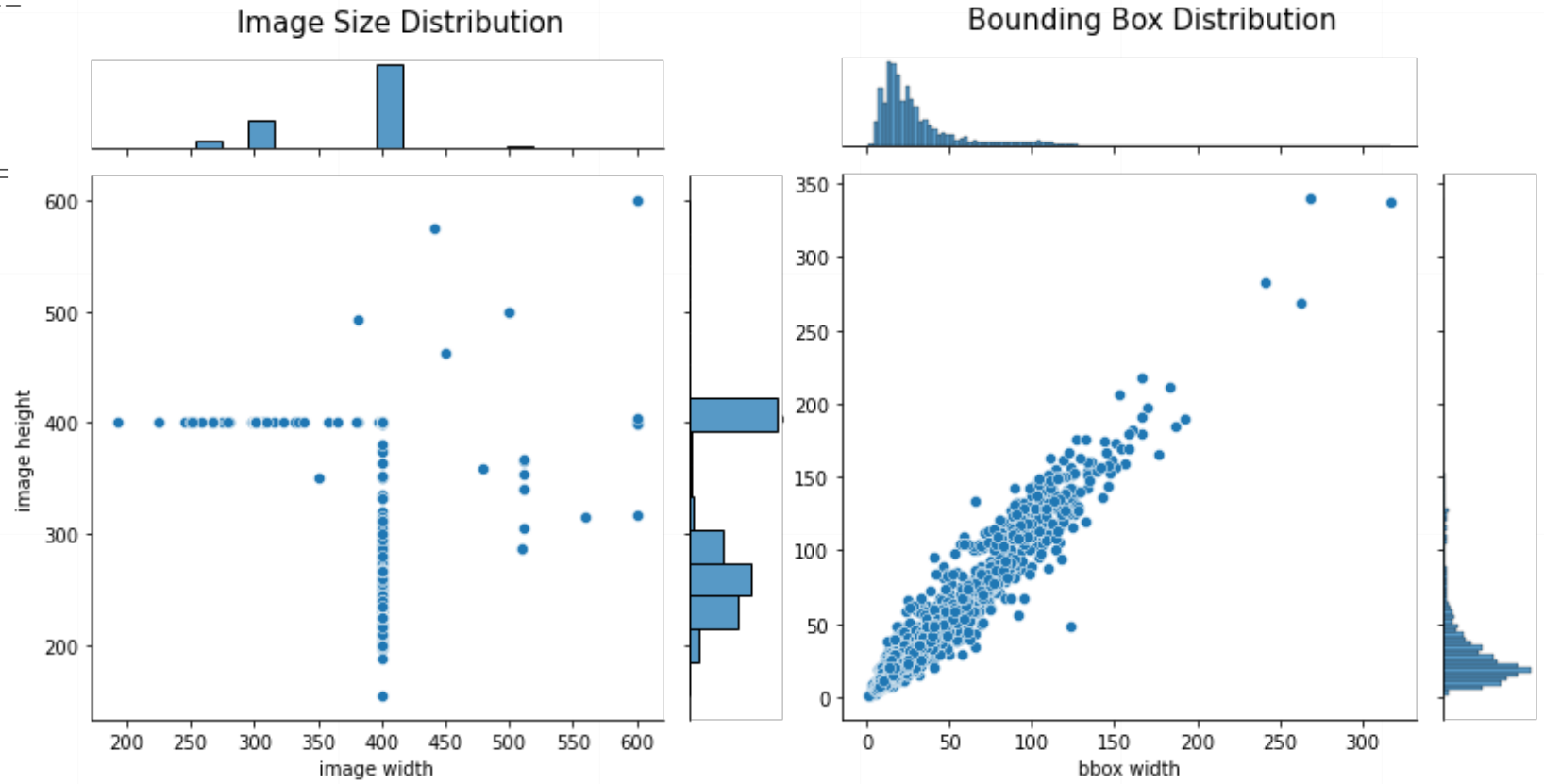
Check image size distribution

- ====== Bounding boxes statistics ======
- median width : 22.0
- median height: 24.0

- ============ Image statistics ========
- median width : 280.5
- median height: 280.5

Class distribution

- mask 0.79
- no_mask 0.18
- incorrect 0.03



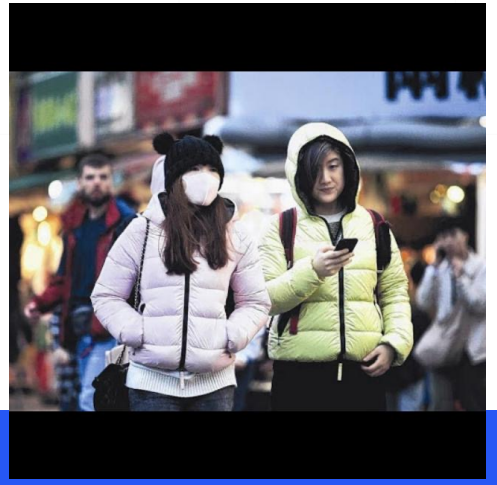
Preprocessing - Roboflow image processing tool

Train, validation, split

- 70%, 20%, 10% split (593, 170, 85 images respectively)
- Class imbalance, hence split need to be stratify
- Roboflow does the split quite effortlessly ensuring that each class is represented in the correct proportion.

Image resizing

- Resized to square ratio, selected 640x640 and 320x320
- To maintained the aspect ration, padding is required. Black pixels used.



Preprocessing - Roboflow image processing tool

Image augmentation

- (1) horizontal flip, (2) +-10° rotation, and (3) applied mosaic
- Increase the training data from 593 -> 1,779 (~ 3 times)
- Note that validation and test set remained at 170 and 85 images. Ground truth images, they should not be augmented.

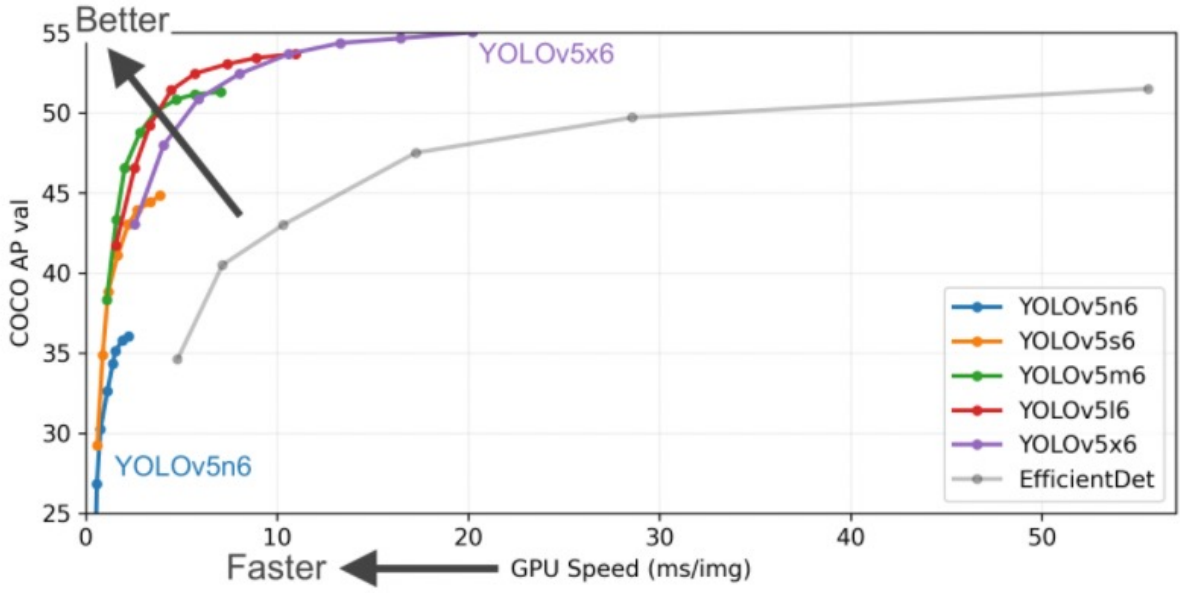
Modelling – YOLOv5

4 different runs

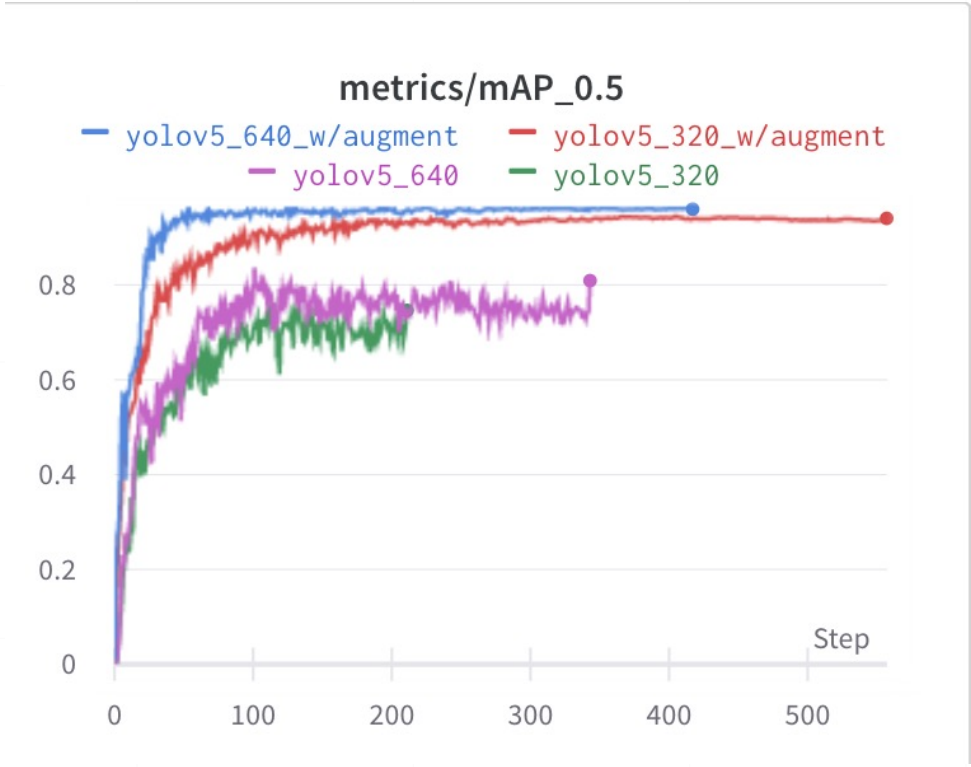
1. input image size 320, with no augmentations
2. input image size 320, with augmentations
3. input image size 640, with no augmentations
4. input image size 640, with augmentations

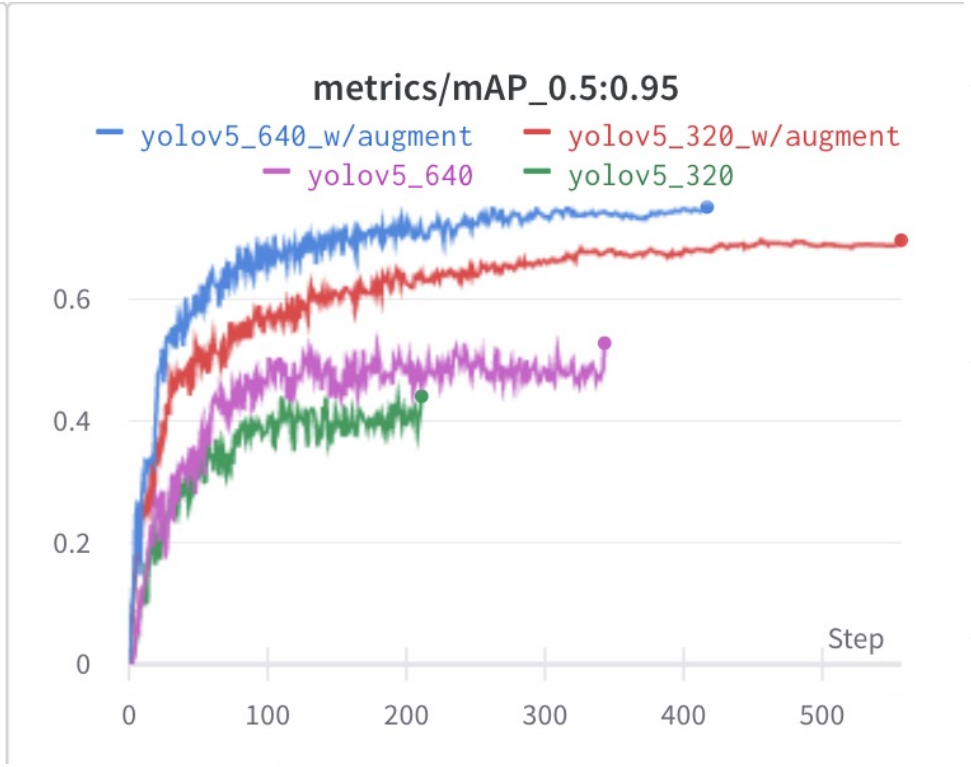
Transfer learning

1. Pre-trained weights yolovs
2. “S” category is a lighter model, faster inference speed, but lesser accuracy

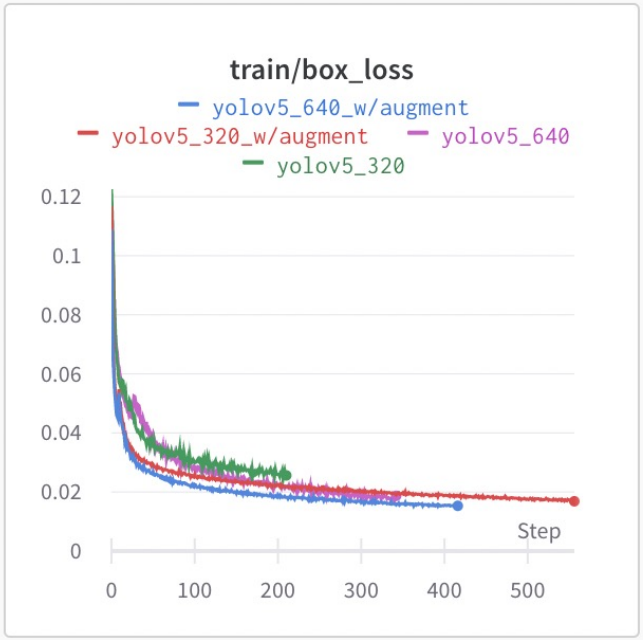


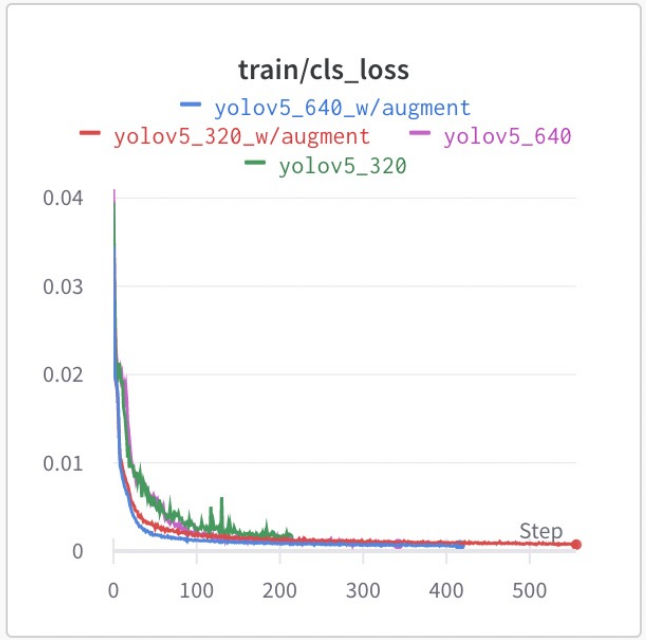
Results – Weights and Biases

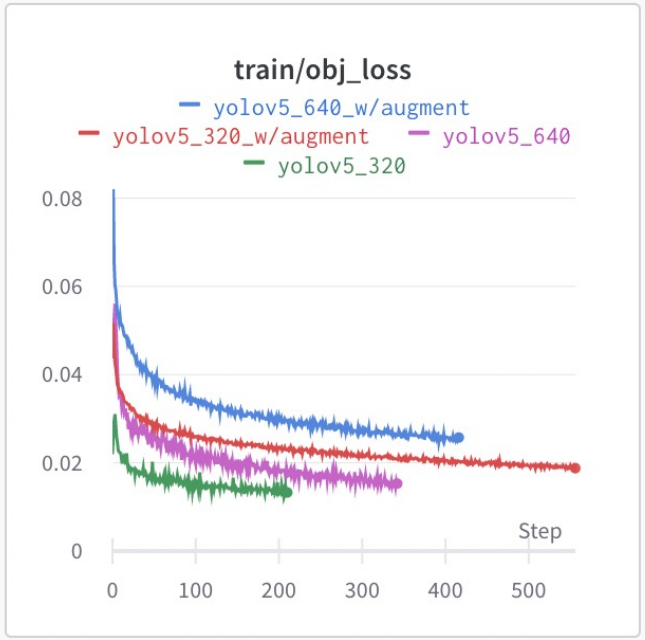


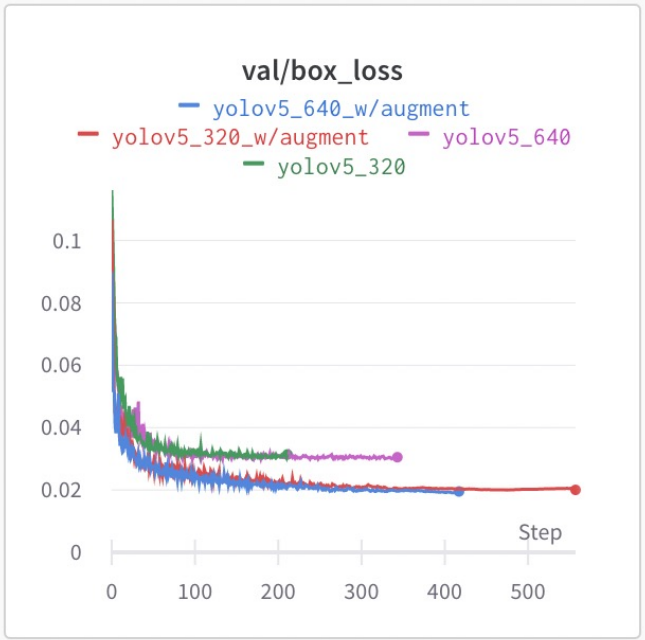


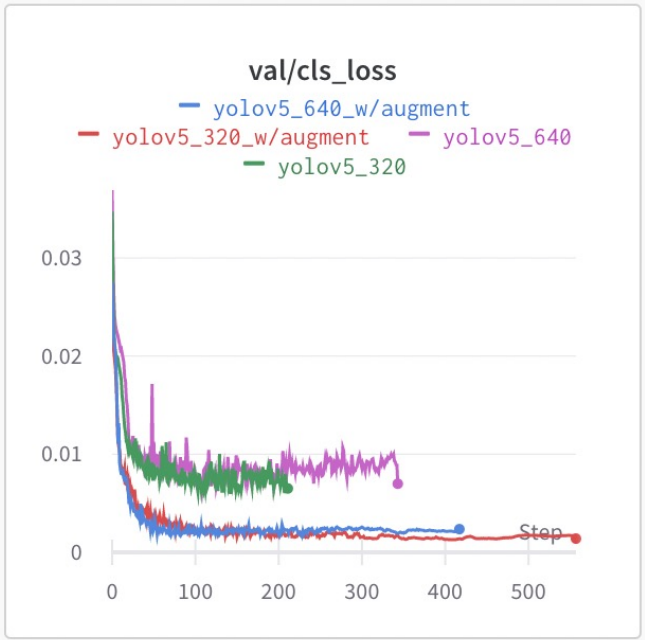
Results

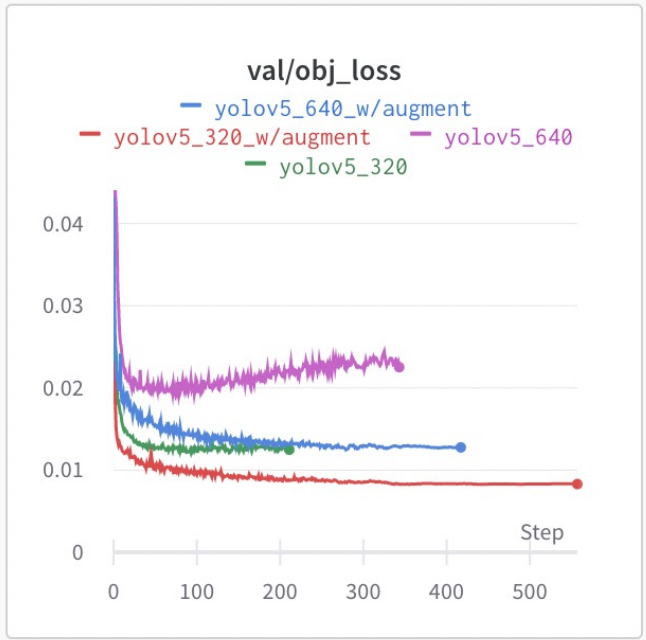

train/box_loss
yolov5_640_w/augment
yolov5_320_w/augment
yolov5_640
yolov5_320
0.12
0.1
0.08
0.06
0.04
0.02
0
Step
0
100
200
300
400
500


train/cls_loss
yolov5_640_w/augment
yolov5_320_w/augment
yolov5_640
yolov5_320
0.04
0.03
0.02
0.01
0
Step
0
100
200
300
400
500


train/obj_loss
yolov5_640_w/augment
yolov5_320_w/augment
yolov5_640
yolov5_320
0.08
0.06
0.04
0.02
0
Step
0
100
200
300
400
500


val/box_loss
yolov5_640_w/augment
yolov5_320_w/augment
yolov5_640
yolov5_320
0.1
0.08
0.06
0.04
0.02
0
Step
0
100
200
300
400
500


val/cls_loss
yolov5_640_w/augment
yolov5_320_w/augment
yolov5_640
yolov5_320
0.03
0.02
0.01
0
Step
0
100
200
300
400
500

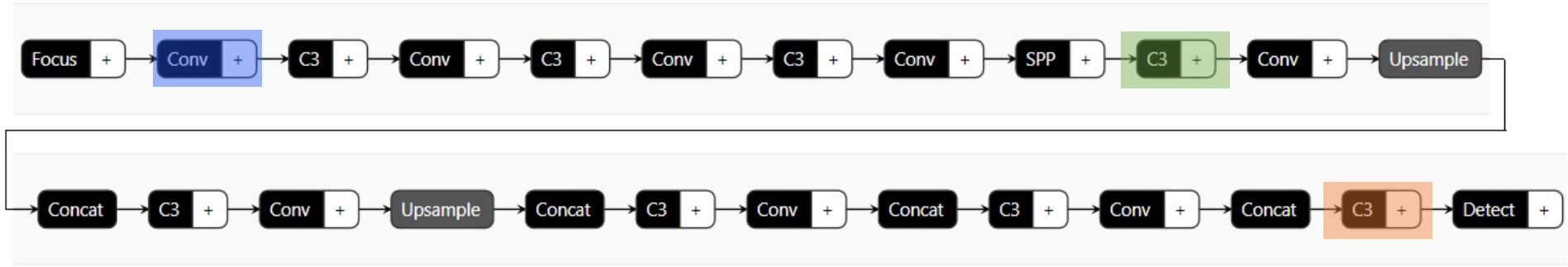

val/obj_loss
yolov5_640_w/augment
yolov5_320_w/augment
yolov5_640
yolov5_320
0.04
0.03
0.02
0.01
0
Step
0
100
200
300
400
500

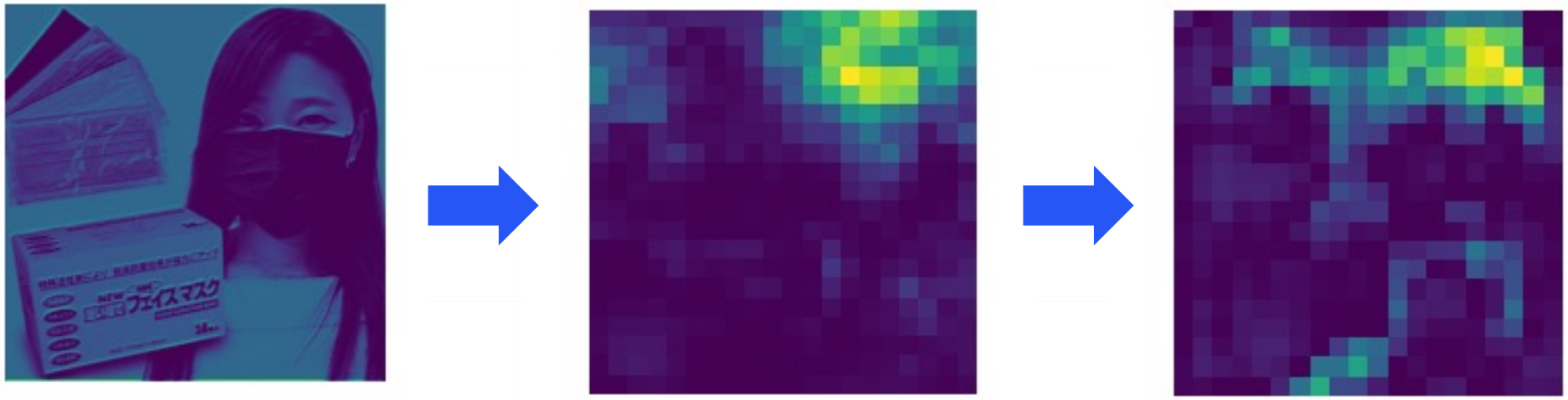
Results - Summary

Models	mAP_0.5	mAP_0.5:0.95
yolov5_640_w/augemnt	0.96	0.75
yolov5_320_w/augemnt	0.94	0.70
yolov5_640	0.81	0.53
yolov5_320	0.75	0.44

Models	Dataset	mAP@.5	mAP@.5:.95
yolov5_640_w/augemnt	validation	0.96	0.752
yolov5_640_w/augemnt	Test	0.977	0.781

Visualizing feature maps





Stage 1

Stage 9

Stage 23

Discussion on inference result

GOOD, BAD, AND UGLY...


Ground Truth: maksssksksss253
no_mask
mask
no_mask
mask
no_mask
mask
mask
incorrect
mask


Inference: maksssksksss253
mask 0.95
no_mask 0.92
mask 0.93
no_mask 0.93
no_mask 0.92
mask 0.95
mask 0.94
incorrect 0.95
mask 0.96

GOOD


Ground Truth: maksssksksss179
Inference: maksssksksss179
mask
no_mask
mask 0.81
no_mask 0.93
no_mask 0.91
mask 0.95
mask 0.73
0
100
200
300
400
500
600

BAD


Ground Truth: maksssksksss633
Inference: maksssksksss633
mask
mask 0.92
0
100
200
300
400
500
600

UGLY


no_mask 0.91
mask 0.87
SOUTH KOREA
URGES CALM
cna
tine with COVID-19
UK tech tycoon Mike Lynch fails in bid to delay extradition ruling

Thanks !