Kaggle
SIIM-FISABIO-RSNA COVID-19 Detection

Triple C
Wenbo Hu

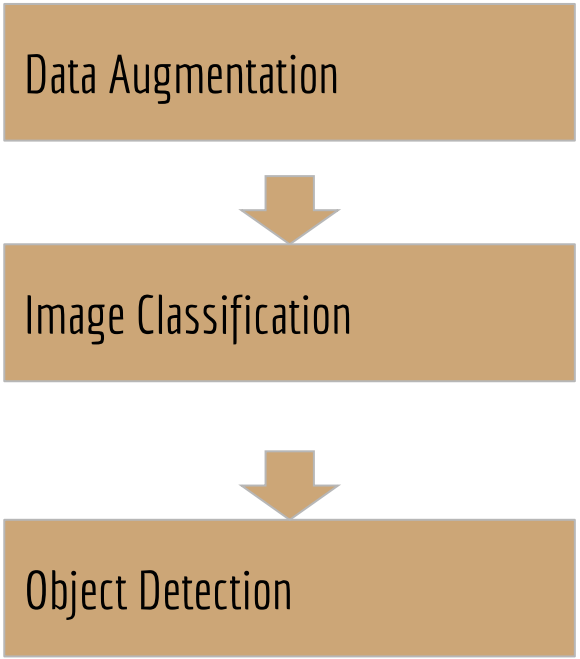
Project intro

- Problem Statement：
  - COVID-19 Test can take a few hours and sometimes days before the molecular test results are back.
  - Solution: Chest radiographs can be obtained in minutes. Non-radiologists could be supported with better localization of the disease, such as with a visual bounding box.
- Goals：
  - In this competition, you'll identify and localize COVID-19 abnormalities on chest radiographs. In particular, we'll categorize the radiographs as negative for pneumonia or typical, indeterminate, or atypical for COVID-19.
- Team：
  - Developer: Wenbo Hu, Xinrui Zhan, Kewen Zhao, Albert Kong, Yung-Chieh (Jerry) Chan

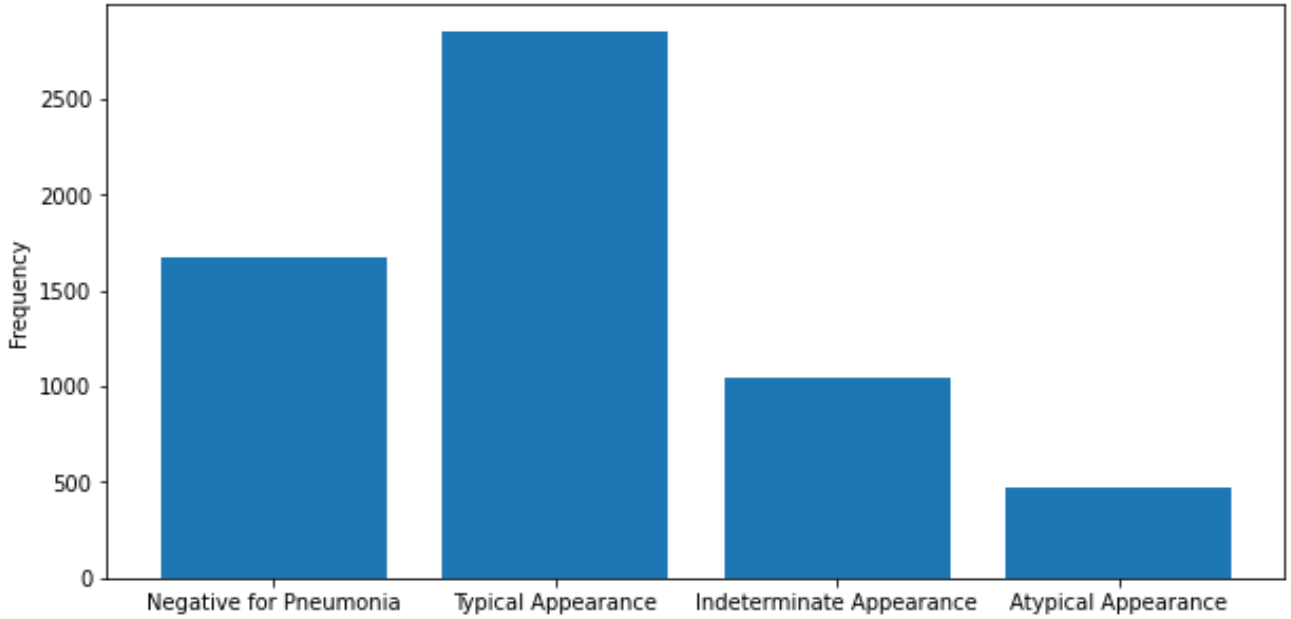
EDA

```
dicom_paths = get_dicom_files(dataset_path/'train')
imgs = [dicom2array(path) for path in dicom_paths[:4]]
plot_imgs(imgs)
```

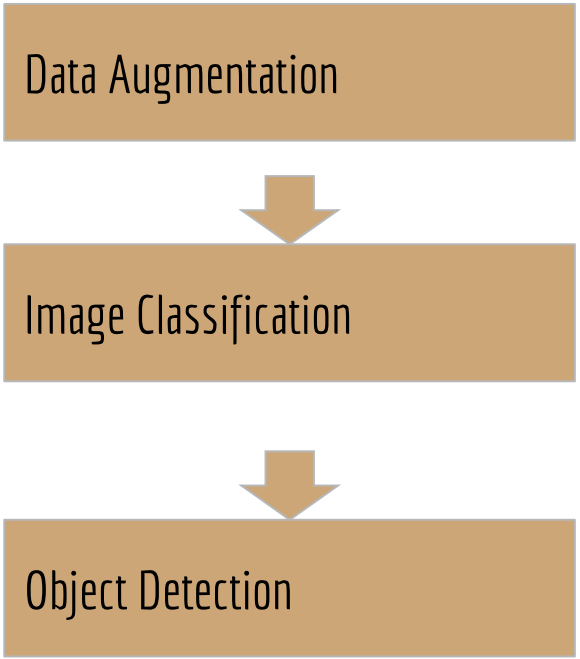
WorkFlow


Data Augmentation
Image Classification
Object Detection

EDA


Frequency
2500
2000
1500
1000
500
0
Negative for Pneumonia
Typical Appearance
Indeterminate Appearance
Atypical Appearance

WorkFlow


Data Augmentation
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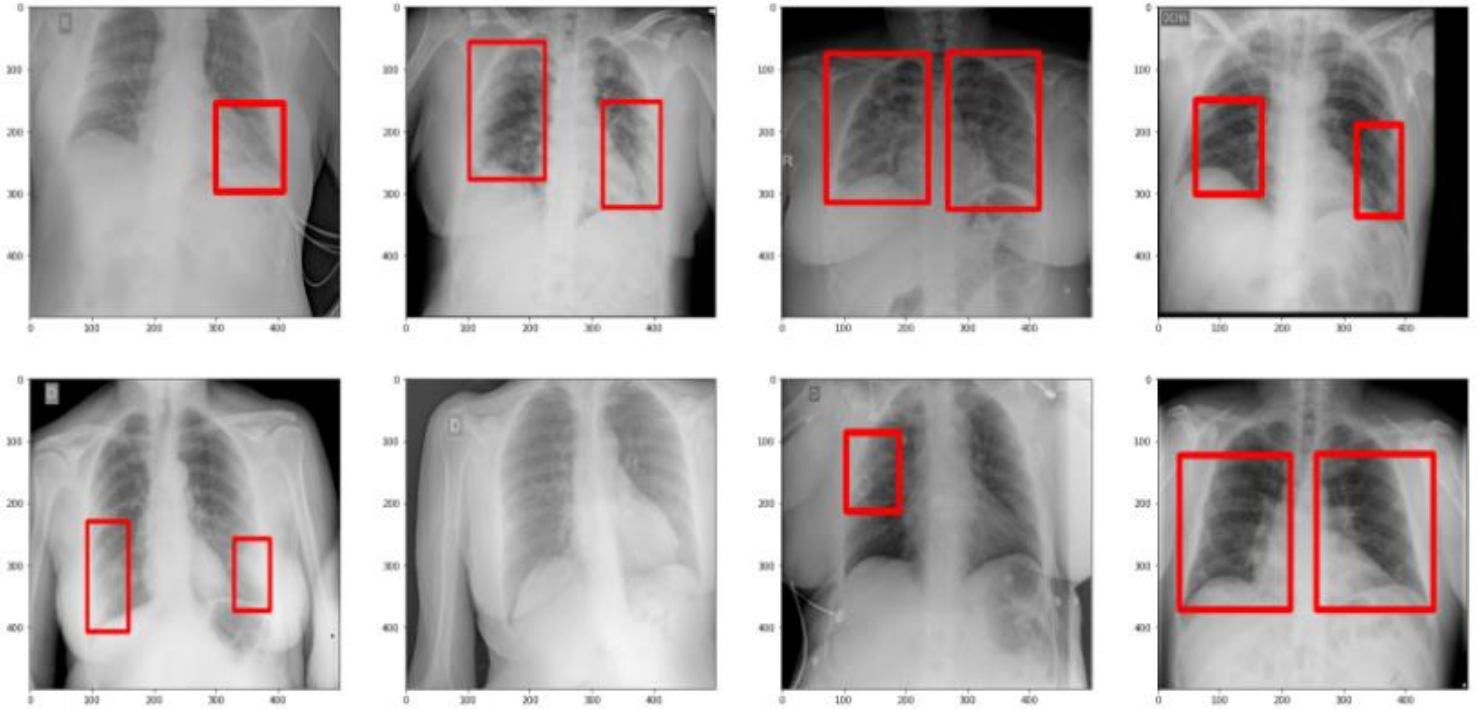
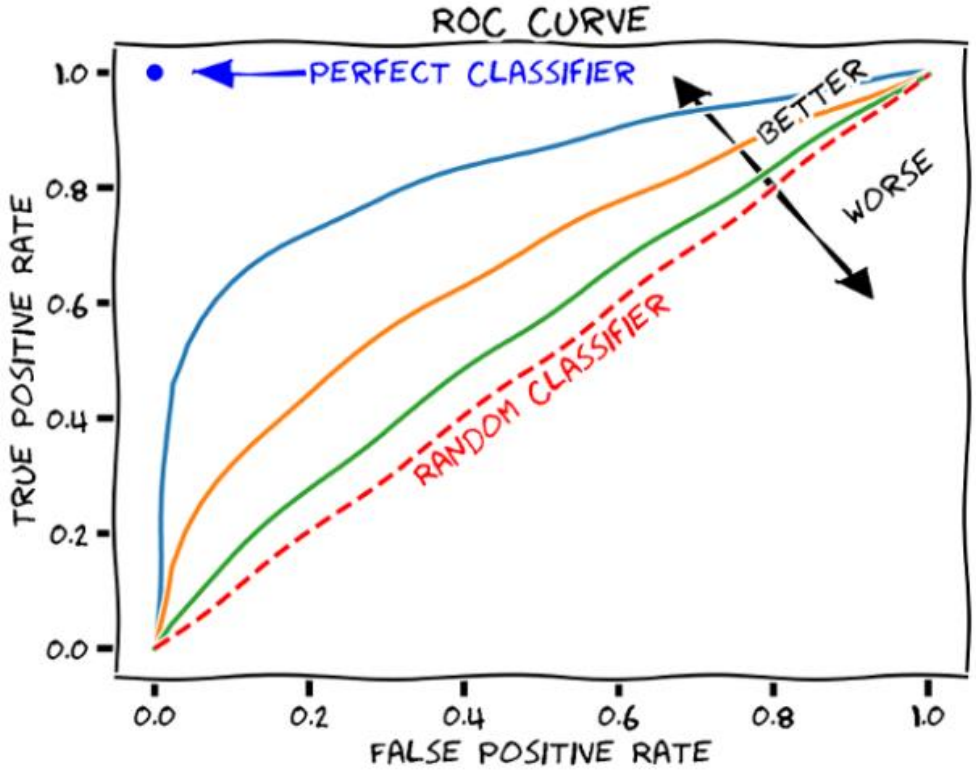
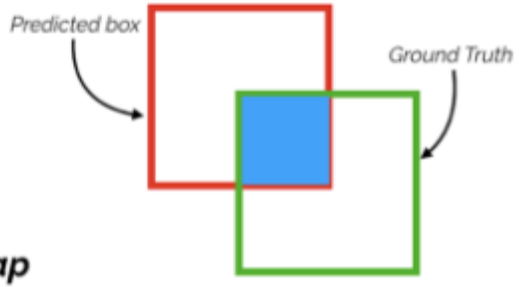


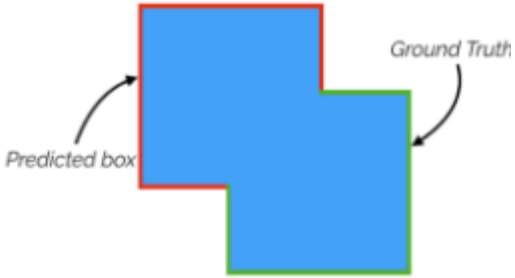
Evaluation Metric - AUC (Area Under ROC Curve)



Evaluation Metric - mAP at IoU › 0.5



$$\textit{Intersection over Union (IoU)} = \frac{\textit{Area of Overlap}}{\textit{Area of Union}} =$$

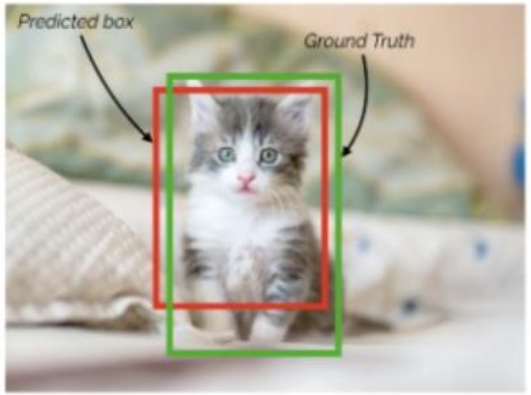


Evaluation Metric - mAP at IoU > 0.5

$$Precision = \frac{TP}{TP + FP}$$

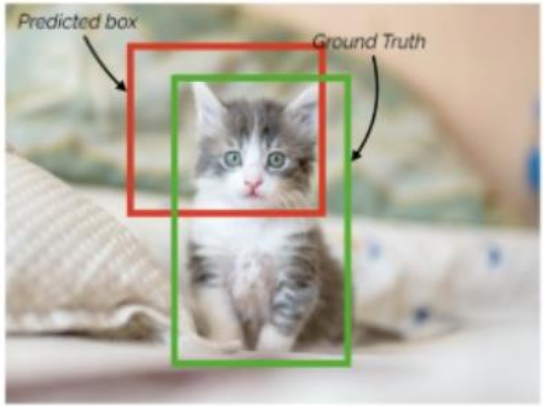
If IoU threshold = 0.5

True Positive (TP)



IoU = ~0.7

False Positive (FP)



IoU = ~0.3

WorkFlow

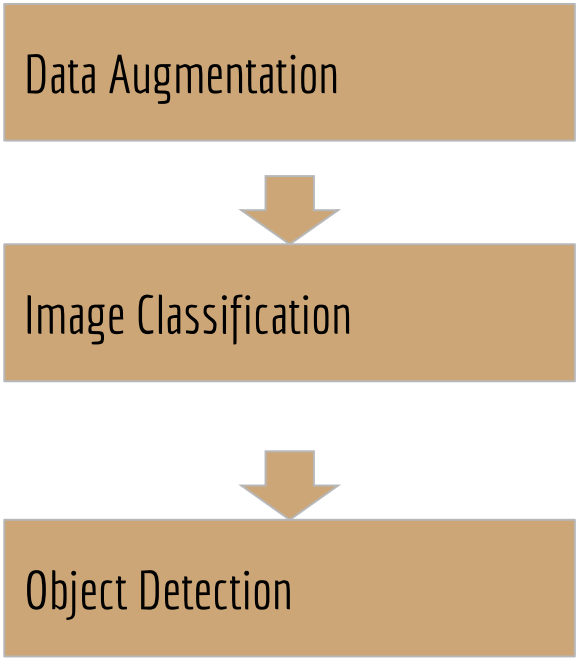
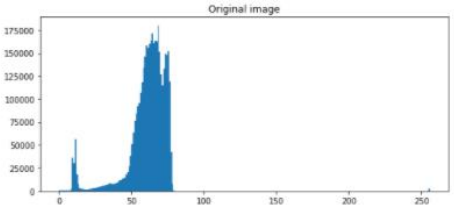

Data Augmentation
Image Classification
Object Detection

Image Enhancement - Histogram Equalization

Show hidden code



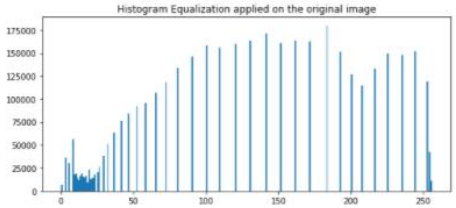
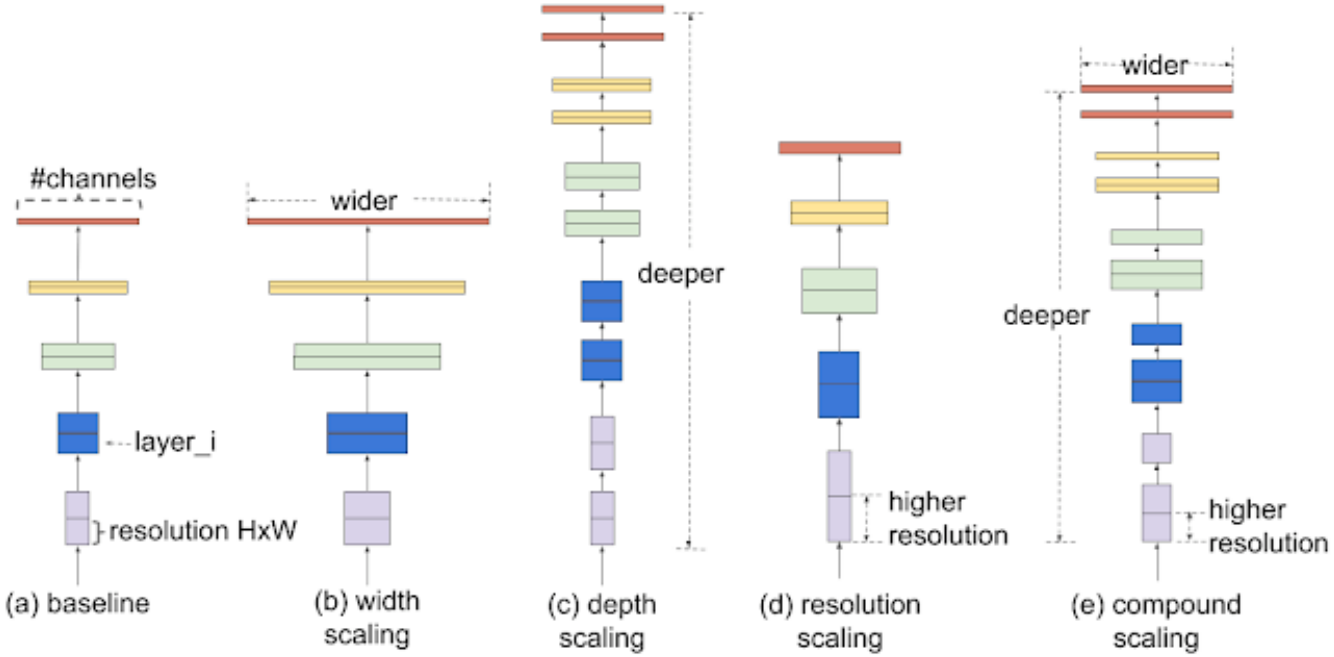


Image Enhancement -CLAHE Contrast Limited Adaptive Histogram Equalization

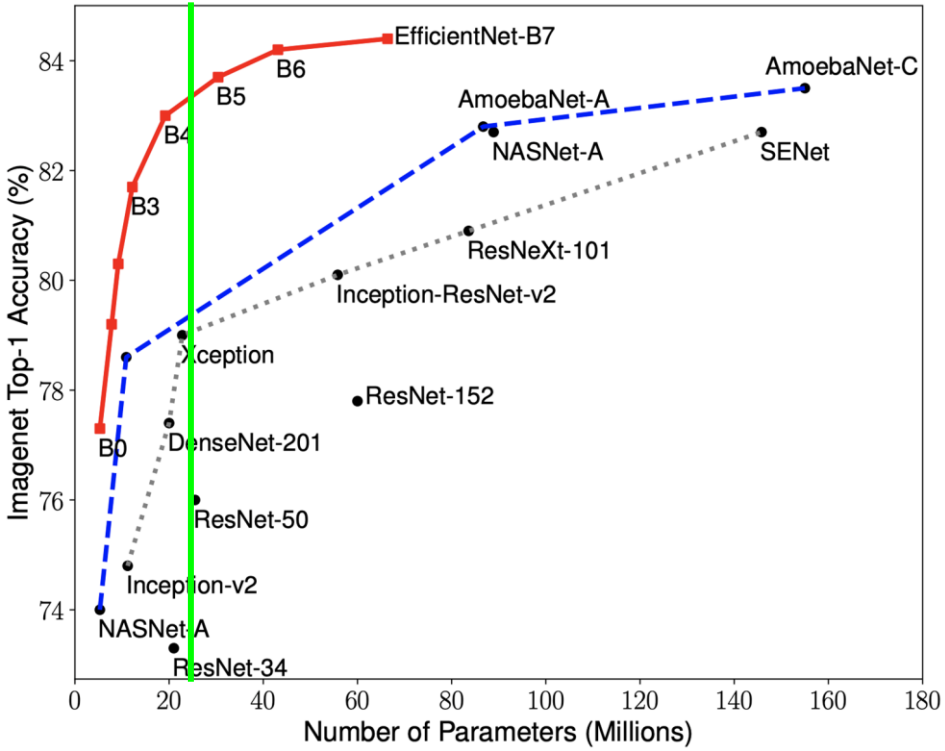
Image Augmentation - Traditional

- Albumentations
  - Random Resized Crop
  - Shift Scale Rotate
  - Horizontal Flip
  - Vertical Flip
  - Blur
  - CLAHE
  - IAA Sharpen
  - IAA Emboss
  - Random Brightness Contrast
  - Cutout

Classification - EfficientNet

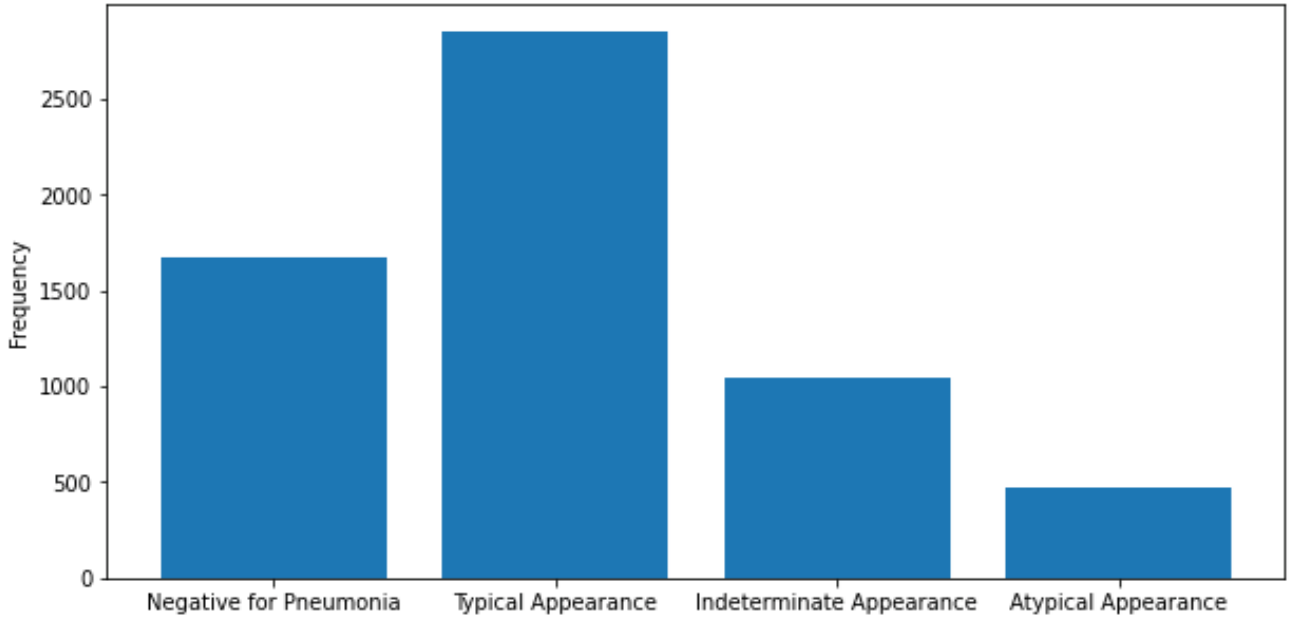


Classification - EfficientNet

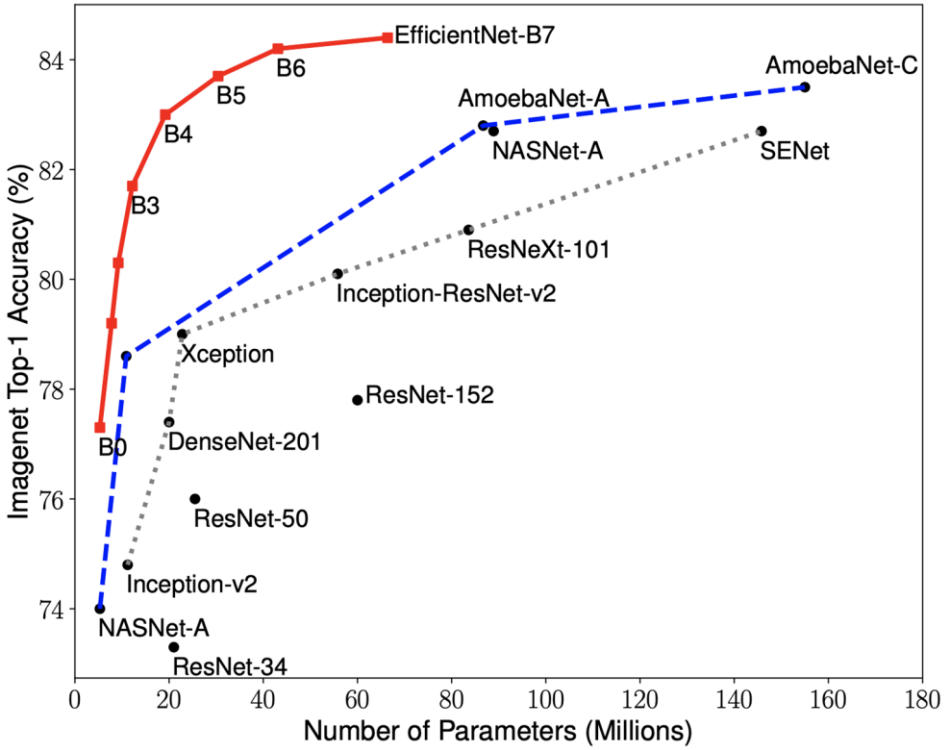


Achieved 0.802 validation auc for our dataset

Class Distribution



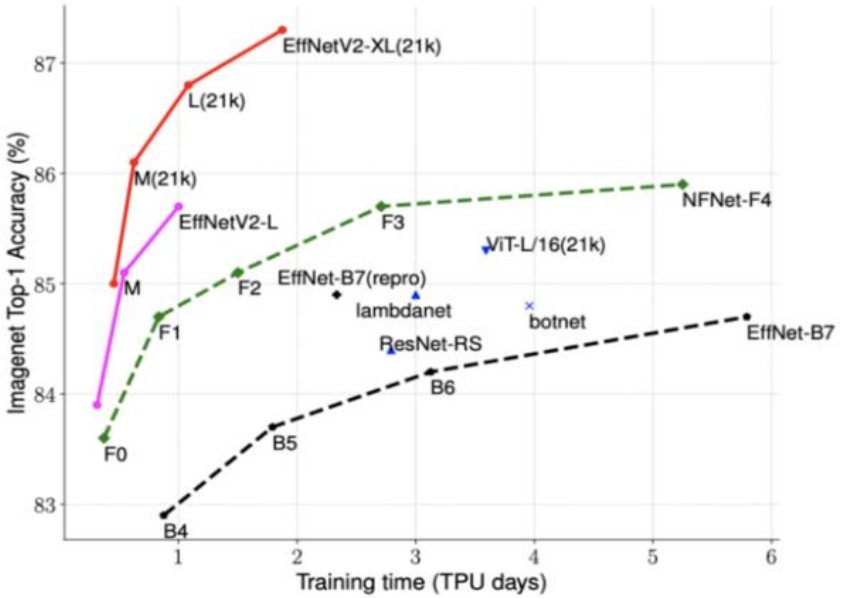
Classification - EfficientNet



Achieved 0.802 validation auc for our dataset

Training Binary Class:
0.88 validation auc

Classification - EfficientNetV2 + Weight&Bias

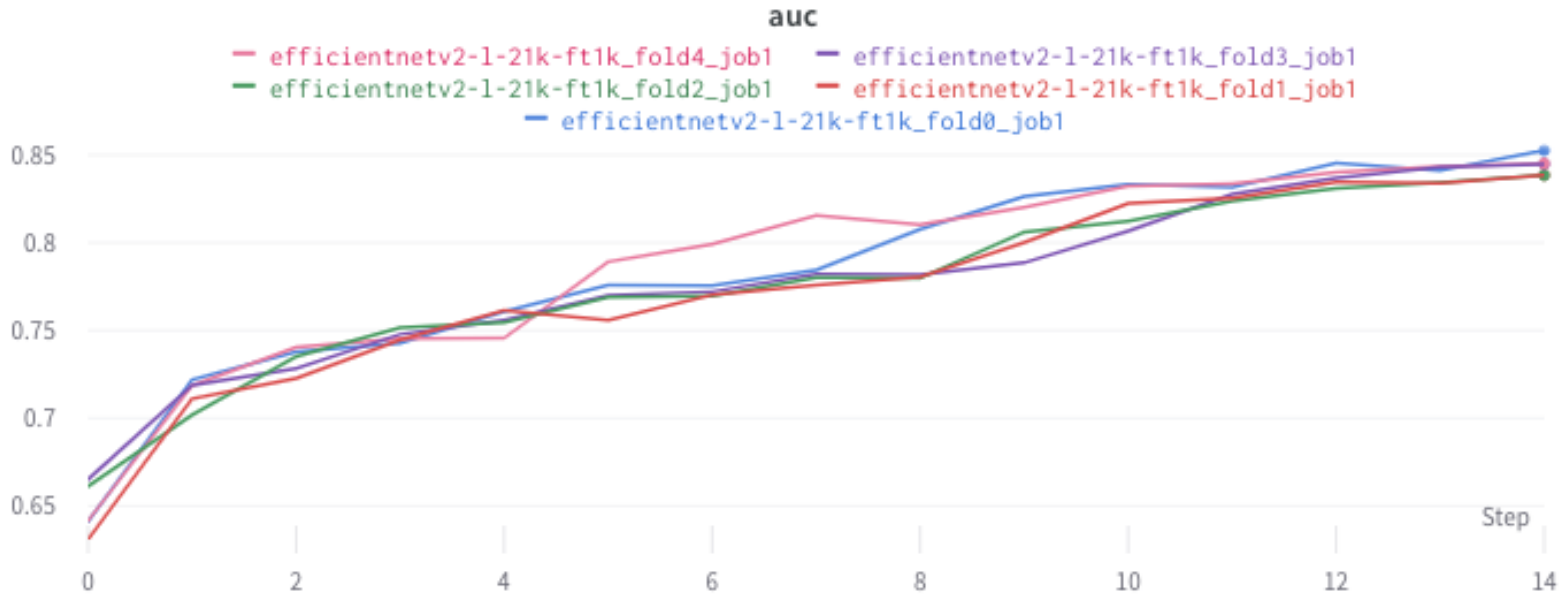


(a) Training efficiency.

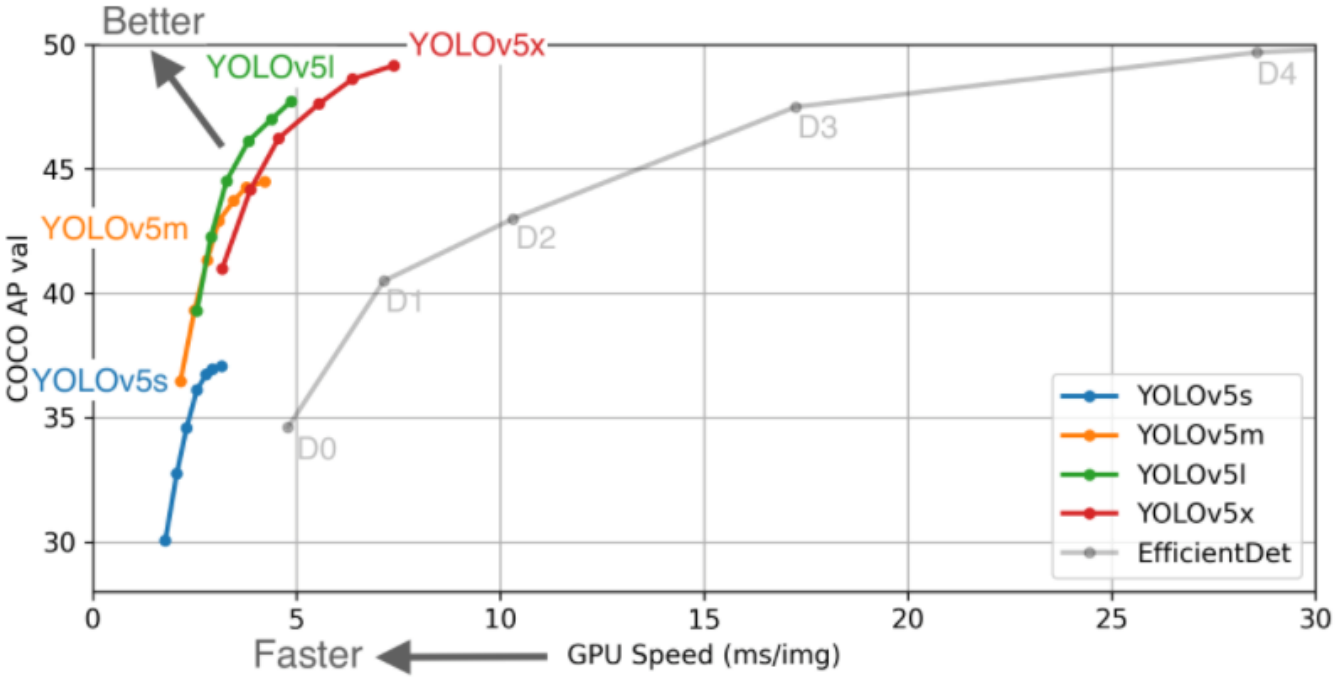
	EfficientNet (2019)	ResNet-RS (2021)	DeiT/ViT (2021)	EfficientNetV2 (ours)
Top-1 Acc.	84.3%	84.0%	83.1%	83.9%
Parameters	43M	164M	86M	24M

Achieved 0.81 validation auc for our dataset

EfficientNetV2 + Weight&Bias + CrossValidation



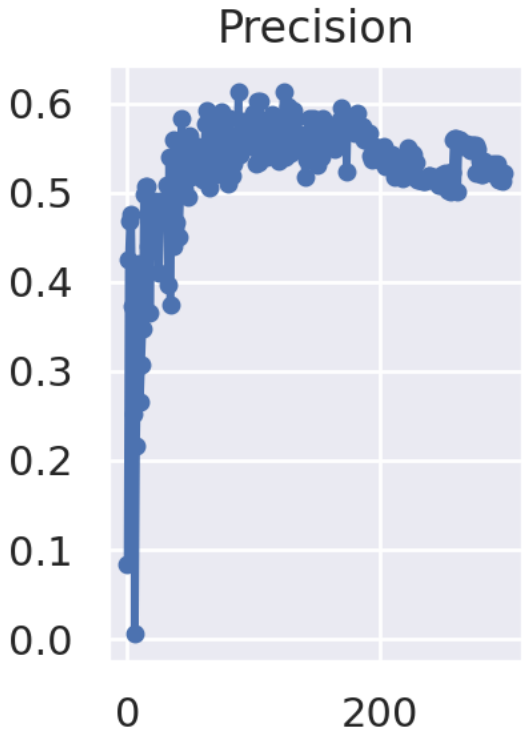
Detection - YoloV5

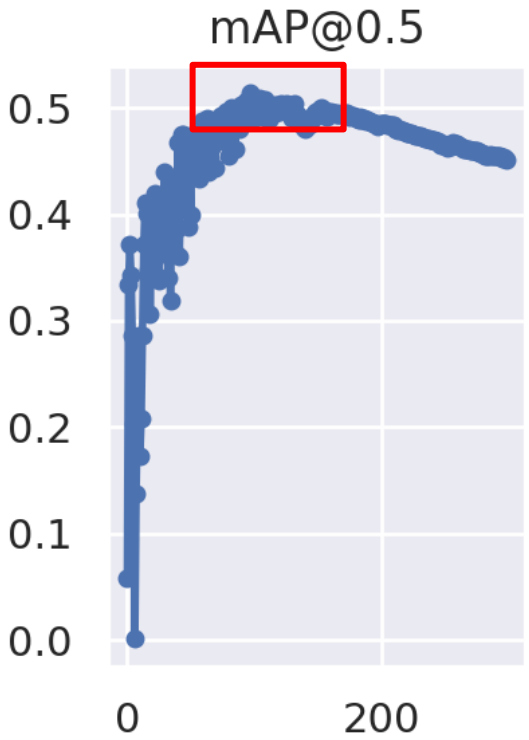


hyp.yaml

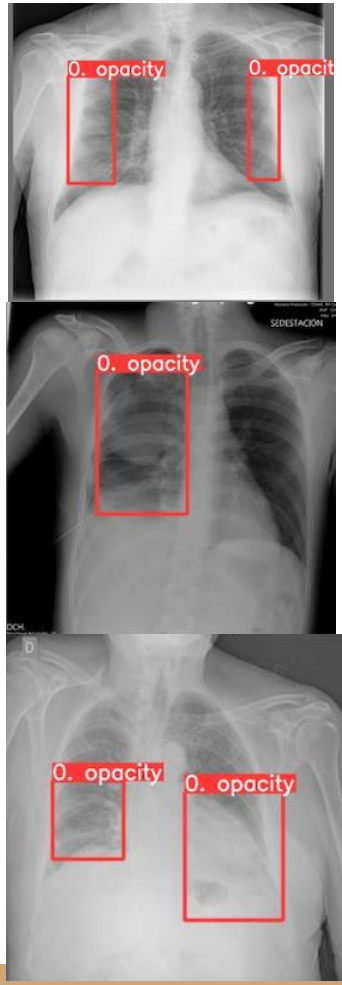
```
lr0: 0.01
lrf: 0.032
momentum: 0.937
weight_decay: 0.0005
warmup_epochs: 3.0
warmup_momentum: 0.8
warmup_bias_lr: 0.1
box: 0.1
cls: 1.0
cls_pw: 0.5
obj: 2.0
obj_pw: 0.5
iou_t: 0.2
anchor_t: 4.0
anchors: 0
fl_gamma: 0.0
hsv_h: 0.015
hsv_s: 0.7
hsv_v: 0.4
degrees: 0.0
translate: 0.2
scale: 0.6
shear: 0.0
perspective: 0.0
flipud: 0.2
fliplr: 0.5
mosaic: 1.0
mixup: 0.0
copy_paste: 0.0
```

Detection - YoloV5

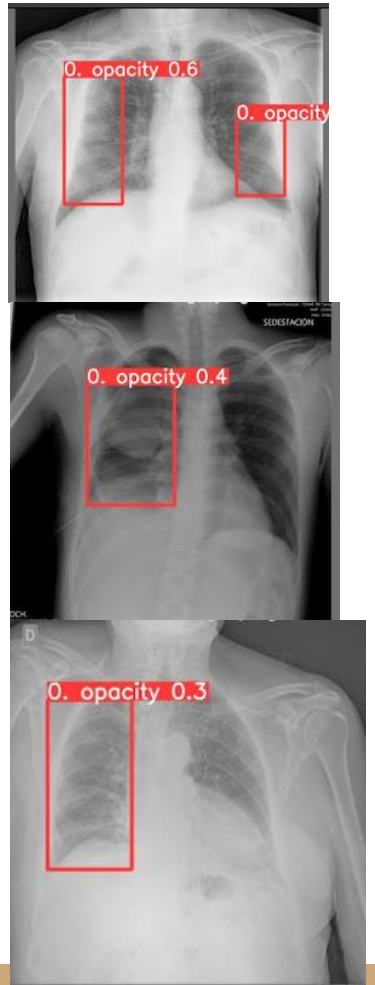




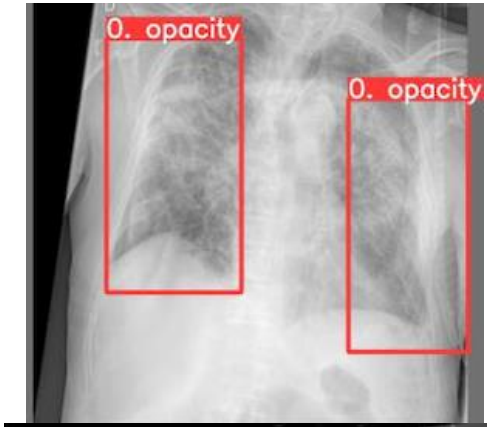
Ground Truth

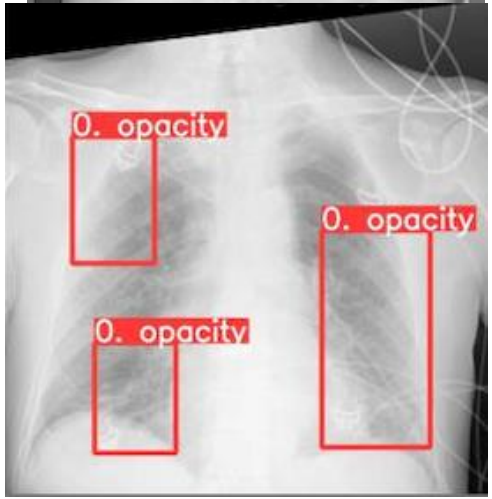


Predicted

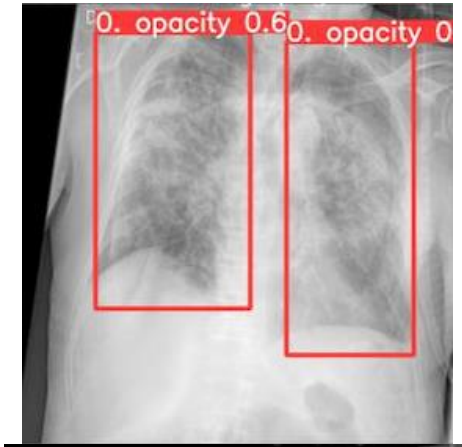


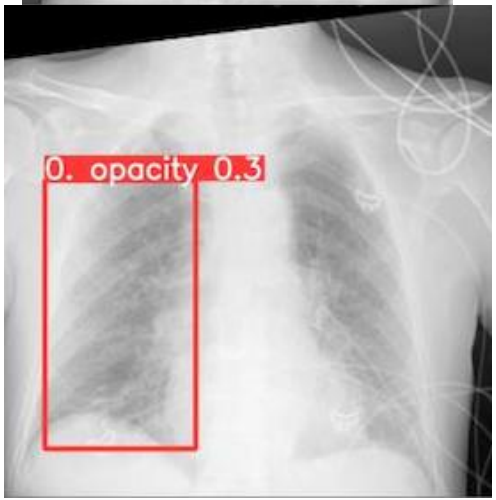
Ground Truth





Predicted





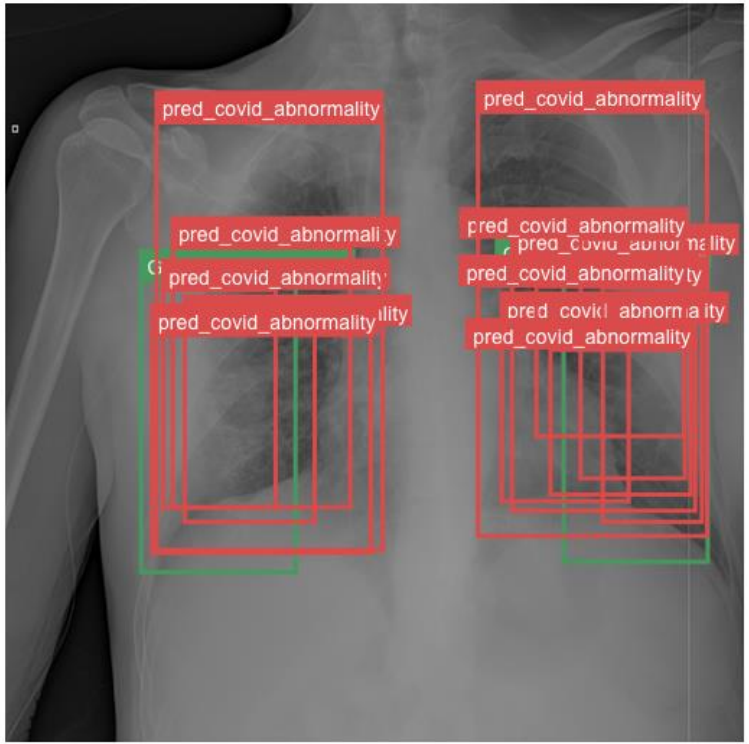
Detection - YoloV5 Test Time Augmentation (TTA)

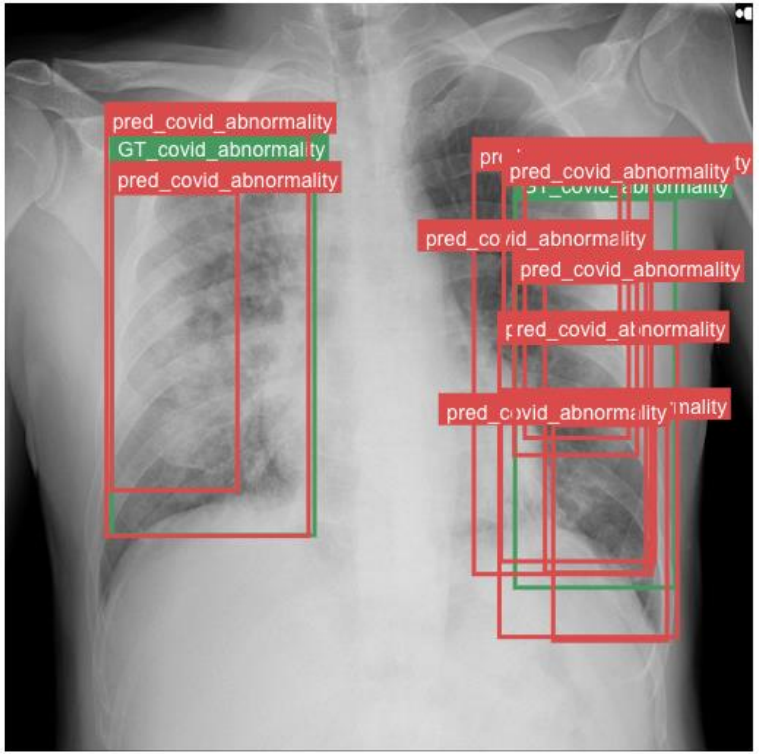
```
val: data=./data/coco.yaml, weights=['yolov5x.pt'], batch_size=32, imgsz=640, conf_thres=0.001, iou_thres=0.65,
YOLOv5 🚀 v5.0-267-g6a3ee7c torch 1.9.0+cu102 CUDA:0 (Tesla P100-PCIE-16GB, 16280.875MB)

Fusing layers...
Model Summary: 476 layers, 87730285 parameters, 0 gradients

val: Scanning '../datasets/coco/val2017' images and labels...4952 found, 48 missing, 0 empty, 0 corrupted: 100
val: New cache created: ../datasets/coco/val2017.cache
               Class     Images     Labels          P          R     mAP@.5 mAP@.5:.95: 100% 157/157 [02:30<00:
                 all       5000      36335      0.746      0.626       0.68       0.49
Speed: 0.1ms pre-process, 22.4ms inference, 1.4ms NMS per image at shape (32, 3, 640, 640)  # <--- baseline spe

Evaluating pycocotools mAP... saving runs/val/exp/yolov5x_predictions.json...
...
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.504  # <--- baseline mAP
 Average Precision  (AP) @[ IoU=0.50       | area=   all | maxDets=100 ] = 0.688
 Average Precision  (AP) @[ IoU=0.75       | area=   all | maxDets=100 ] = 0.546
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.351
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.551
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.644
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.382
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.628
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.681  # <--- baseline mAR
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.524
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.735
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.826
```

```
size=32, imgsz=832, conf_thres=0.001, iou_thres
a P100-PCIE-16GB, 16280.875MB)

.py:718: UserWarning: Named tensors and all their as
ing, dilation, ceil_mode)

...4952 found, 48 missing, 0 empty, 0 corrupted: 100
     R     mAP@.5 mAP@.5:.95: 100% 157/157 [07:29<00
 0.656      0.695      0.503
image at shape (32, 3, 832, 832)  # <--- TTA speed

_predictions.json...

maxDets=100 ] = 0.516  # <--- TTA mAP
maxDets=100 ] = 0.701
maxDets=100 ] = 0.562
maxDets=100 ] = 0.361
maxDets=100 ] = 0.564
maxDets=100 ] = 0.656
maxDets=  1 ] = 0.388
maxDets= 10 ] = 0.640
maxDets=100 ] = 0.696  # <--- TTA mAR
maxDets=100 ] = 0.553
maxDets=100 ] = 0.744
maxDets=100 ] = 0.833
```

MMDetection + CascadeRCNN + Weight&Bias

MMDetection + CascadeRCNN + Weight&Bias





Ensemble - WBF (Weighted Box Fusion)

Method	mAP(0.5) Result
NMS	0.5642
Soft-NMS	0.5616
NMW	0.5667
WBF	**0.5982**

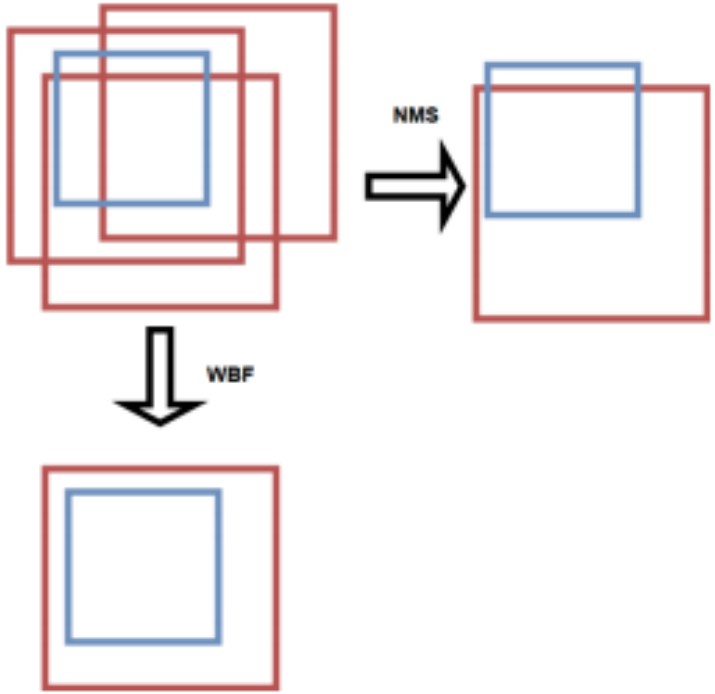
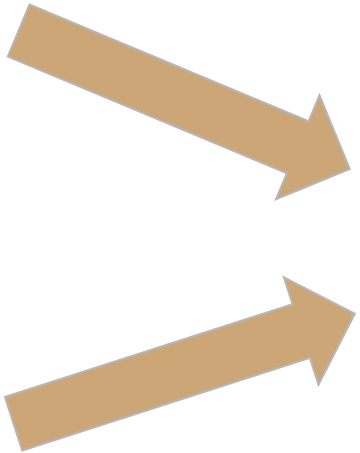


Figure 1. NMS vs WBF boxes.

Ensemble Everything

- Classification (auc = 0.83)
  - EfficientNetB7
  - EfficientNetV2
  - Resnet152
  - Resnet101
  - DenseNet 201
  - DenseNet 121

- Detection (mAP@0.5 = 0.54)
  - YoloV5s
  - YoloV5x6 + TTA
  - CascadeRCNN



LB Score:
0.614
(Beat 1200 teams)

THANK YOU

Q&A