

- Configuration Model.
- Train Model.
- Evaluation Model

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```
[1]: !git clone https://github.com/ultralytics/yolov5 # clone
!pip install -qr yolov5/requirements.txt # install
```

```
Cloning into 'yolov5'...
remote: Enumerating objects: 13310, done.
remote: Counting objects: 100% (72/72), done.
remote: Compressing objects: 100% (33/33), done.
remote: Total 13310 (delta 51), reused 48 (delta 39), pack-reused 13238
Receiving objects: 100% (13310/13310), 12.01 MiB | 7.48 MiB/s, done.
Resolving deltas: 100% (9271/9271), done.
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager. It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv
```

```
[2]: import pandas as pd
import numpy as np
import os
remote: Total 13310 (delta 51), reused 48 (delta 39), pack-reused 13238
Receiving objects: 100% (13310/13310), 12.01 MiB | 7.48 MiB/s, done.
Resolving deltas: 100% (9271/9271), done.
WARNING: Running pip as the 'root' user can result in broken permissions and conflicting behaviour with the system package manager. It is recommended to use a virtual environment instead: https://pip.pypa.io/warnings/venv
```

```
[2]: import pandas as pd
import numpy as np
import os
import glob
from datetime import datetime
import xml.etree.ElementTree as ET
import cv2
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

Annotation Read and Handling.

```
[3]: path_an = "../input/face-mask-detection/annotations"
```

```
[4]: dataset = {
    "file": [],
    "name": [],
    "width": [],
    "height": [],
    "xmin": [],
    "ymin": [],
    "xmax": [],
    "ymax": []
}
```

```
[5]: for anno in glob.glob(path_an+"/*.xml"):
    tree = ET.parse(anno)

    for elem in tree.iter():
        if 'size' in elem.tag:
            for attr in list(elem):
                if 'width' in attr.tag:
                    width = int(round(float(attr.text)))
                if 'height' in attr.tag:
                    height = int(round(float(attr.text)))

        if 'object' in elem.tag:
            for attr in list(elem):

                if 'name' in attr.tag:
                    name = attr.text
                    dataset['name']+= [name]
                    dataset['width']+= [width]
                    dataset['height']+= [height]
                    dataset['file']+= [anno.split('/')[-1][0:-4]]
```

```

if 'bndbox' in attr.tag:
    for dim in list(attr):
        if 'xmin' in dim.tag:
            xmin = int(round(float(dim.text)))
            dataset['xmin'].append(xmin)
        if 'ymin' in dim.tag:
            ymin = int(round(float(dim.text)))
            dataset['ymin'].append(ymin)
        if 'xmax' in dim.tag:
            xmax = int(round(float(dim.text)))
            dataset['xmax'].append(xmax)
        if 'ymax' in dim.tag:
            ymax = int(round(float(dim.text)))
            dataset['ymax'].append(ymax)

```

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[6]:

```
df=pd.DataFrame(dataset)
df.head()
```

	file	name	width	height	xmin	ymin	xmax	ymax
0	makssskssss737	with_mask	400	226	28	55	46	71
1	makssskssss737	with_mask	400	226	98	62	111	78
2	makssskssss737	mask_weared_incorrect	400	226	159	50	193	90
3	makssskssss737	with_mask	400	226	293	59	313	80
4	makssskssss737	with_mask	400	226	352	51	372	72

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[7]:

```
name_dict = {
    'with_mask': 0,
    'mask_weared_incorrect': 1,
    'without_mask': 2
}
```

[8]:

```
df['class'] = df['name'].map(name_dict)
```

[9]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4072 entries, 0 to 4071
Data columns (total 9 columns):
 #   Column   Non-Null Count  Dtype  
 --- 
 0   file     4072 non-null   object 
 1   name     4072 non-null   object 
 2   width    4072 non-null   int64  
 3   height   4072 non-null   int64  
 4   xmin     4072 non-null   int64  
 5   ymin     4072 non-null   int64  
 6   xmax     4072 non-null   int64  
 7   ymax     4072 non-null   int64  
 8   class    4072 non-null   int64  
 dtypes: int64(7), object(2)
 memory usage: 286.4+ KB
```

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[10]:

```
np.sort(df.name.unique())
```

[10]:

```
array(['mask_weared_incorrect', 'with_mask', 'without_mask'], dtype=object)
```

Split Data to Train, Validation, and Test.

[11]:

```
fileNames = [*os.listdir("../input/face-mask-detection/images")]
len(fileNames)
```

[11]:

```
853
```

[14]:

```

from sklearn.model_selection import train_test_split

seed = 42

train, test = train_test_split(fileNames, test_size=0.15, random_state=seed)
test, val = train_test_split(test, test_size=0.7, random_state=seed)
print("Length of Train =", len(train))
print("Length of Valid =", len(val))
print("Length of test =", len(test))

```

```
Length of Train = 725
=====
Length of Valid = 90
=====
Length of test = 38
```

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```
[15]:  
os.mkdir('./yolov5/data/train')  
os.mkdir('./yolov5/data/val')  
os.mkdir('./yolov5/data/test')  
os.mkdir('./yolov5/data/train/images')  
os.mkdir('./yolov5/data/train/labels')  
os.mkdir('./yolov5/data/test/images')  
os.mkdir('./yolov5/data/test/labels')  
os.mkdir('./yolov5/data/val/images')  
os.mkdir('./yolov5/data/val/labels')
```

```
[16]:  
from PIL import Image  
  
def copyImages(imageList, folder_Name):  
    for image in imageList:  
        img = Image.open("../input/face-mask-detection/images/"+image)  
        img1 = img.resize((640, 480))  
        _ = img1.save("./yolov5/data/"+folder_Name+"/images/"+image)
```

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```
[17]:  
copyImages(train, "train")  
copyImages(val, "val")  
copyImages(test, "test")
```

[18]: df.head()

```
[18]:  
file name width height xmin ymin xmax ymax class  
0 makssskss737 with_mask 400 226 28 55 46 71 0  
1 maksskss737 with_mask 400 226 98 62 111 78 0  
2 maksskss737 mask_weared_incorrect 400 226 159 50 193 90 1  
3 maksskss737 with_mask 400 226 293 59 313 80 0  
4 maksskss737 with_mask 400 226 352 51 372 72 0
```

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```
[19]:  
df['xmax'] = (640/df['width'])*df['xmax']  
df['ymax'] = (480/df['height'])*df['ymax']  
df['xmin'] = (640/df['width'])*df['xmin']  
df['ymin'] = (480/df['height'])*df['ymin']
```

```
[20]: df[['xmax', 'ymax', 'xmin', 'ymin']] = df[['xmax', 'ymax', 'xmin', 'ymin']].astype('int64')
```

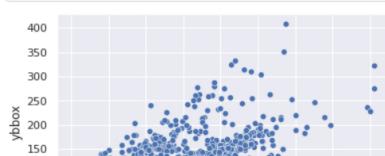
```
[21]:  
df['x_center'] = (df['xmax']+df['xmin'])/(2*640)  
df['y_center'] = (df['ymax']+df['ymin'])/(2*480)  
df['box_height'] = (df['xmax']-df['xmin'])/(640)  
df['box_width'] = (df['ymax']-df['ymin'])/(480)
```

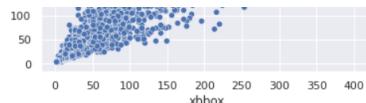
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[22]: df.head()

```
[22]:  
file name width height xmin ymin xmax ymax class x_center y_center box_height box_width  
0 maksskss737 with_mask 400 226 44 116 73 150 0 0.091406 0.277083 0.045312 0.070833  
1 maksskss737 with_mask 400 226 156 131 177 165 0 0.260156 0.308333 0.032813 0.070833  
2 maksskss737 mask_weared_incorrect 400 226 254 106 308 191 1 0.439063 0.309375 0.084375 0.177083  
3 maksskss737 with_mask 400 226 468 125 500 169 0 0.756250 0.306250 0.050000 0.091667  
4 maksskss737 with_mask 400 226 563 108 595 152 0 0.904687 0.270833 0.050000 0.091667
```

```
[23]:  
df['xbbox'] = df['xmax']-df['xmin']  
df['ybbox'] = df['ymax']-df['ymin']  
  
sns.set()  
sns.scatterplot(x='xbbox', y='ybbox', data=df)  
plt.show()
```





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[24]:

```
df = df.astype('string')
```

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[25]:

```
def create_labels(image_list, data_name):
    fileNames = [x.split(".")[0] for x in image_list]

    for name in fileNames:
        data = df[df['file']==name]
        box_list = []

        for index in range(len(data)):
            row = data.iloc[index]
            box_list.append(row['class']+ " "+row["x_center"]+ " "+row["y_center"]\n            +" "+row["box_height"]+ " "+row["box_width"])

        text = "\n".join(box_list)
        with open("./yolov5/data/"+data_name+"/labels/"+name+".txt", "w") as file:
            file.write(text)
```

[26]:

```
create_labels(train, "train")
create_labels(val, "val")
create_labels(test, "test")
```

[27]:

```
%cd yolov5
```

/kaggle/working/yolov5

Configuration Model.

[28]:

```
from IPython.display import Image, Video, clear_output # to display images
import torch
from yolov5 import utils
display = utils.notebook_init()
```

YOLOv5 v6.1-182-g5e077bf torch 1.9.1 CUDA:0 (Tesla P100-PCIE-16GB, 16281MiB)
Setup complete (2 CPUs, 15.6 GB RAM, 3458.9/4030.7 GB disk)

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[30]:

```
!Invidia_smi
```

/bin/bash: nvidia_smi: command not found

[31]:

```
yaml_text = """train: data/train/images
val: data/train/images

nc: 3
names: ['with_mask', 'mask_weared_incorrect', 'without_mask']"""


```

[32]:

```
with open("data/data.yaml", 'w') as file:
    file.write(yaml_text)
```

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[33]:

```
%cat data/data.yaml
```

```
train: data/train/images
val: data/train/images

nc: 3
names: ['with_mask', 'mask_weared_incorrect', 'without_mask']
```

[34]:

```
#customize iPython writefile so we can write variables
from IPython.core.magic import register_line_cell_magic

@register_line_cell_magic
def writetemplate(line, cell):
    with open(line, 'w') as f:
        f.write(cell.format(**globals()))
```

```
[36]: %writetemplate models/custom_yolov5s.yaml

# parameters
nc: 3 # number of classes
depth_multiple: 0.33 # model depth multiple
width_multiple: 0.50 # layer channel multiple

# anchors
anchors:
  - [10,13, 16,30, 33,23] # P3/8
  - [30,61, 62,45, 59,119] # P4/16
  - [116,98, 156,198, 373,326] # P5/32

# YOLOv5 backbone
backbone:
  # [from, number, module, args]
  [[-1, 1, Focus, [64, 3]], # 0-P1/2
  [-1, 1, Conv, [128, 3, 2]], # 1-P2/4
  [-1, 3, BottleneckCSP, [128]],
  [-1, 1, Conv, [256, 3, 2]], # 3-P3/8
  [-1, 9, BottleneckCSP, [256]],
  [-1, 1, Conv, [512, 3, 2]], # 5-P4/16
  [-1, 9, BottleneckCSP, [512]],
  [-1, 1, Conv, [1024, 3, 2]], # 7-P5/32
  [-1, 1, SPP, [1024, [5, 9, 13]]],
  [-1, 3, BottleneckCSP, [1024, False]], # 9
  ]

# YOLOv5 head
head:
  [[[[-1, 1, Conv, [512, 1, 1]],
  [-1, 1, nn.Upsample, [None, 2, 'nearest']],
  [[[-1, 6], 1, Concat, [1]], # cat backbone P4
  [-1, 3, BottleneckCSP, [512, False]], # 13

  [-1, 1, Conv, [256, 1, 1]],
  [-1, 1, nn.Upsample, [None, 2, 'nearest']],
  [[[-1, 4], 1, Concat, [1]], # cat backbone P3
  [-1, 3, BottleneckCSP, [256, False]], # 17 (P3/8-small)

  [-1, 1, Conv, [256, 3, 2]],
  [[[-1, 14], 1, Concat, [1]], # cat head P4
  [-1, 3, BottleneckCSP, [512, False]], # 20 (P4/16-medium)

  [-1, 1, Conv, [512, 3, 2]],
  [[[-1, 10], 1, Concat, [1]], # cat head P5
  [-1, 3, BottleneckCSP, [1024, False]], # 23 (P5/32-large)

  [[[-17, 20, 23], 1, Detect, [nc, anchors]], # Detect(P3, P4, P5)
  ]]
```

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Train Model

```
[36]: # train yolov5s on custom data for 100 epochs
# time its performance
import wandb
from wandb.keras import WandbCallback

wandb.init(config={"hyper": "parameter"})

start = datetime.now()
!python train.py --img 640 --batch 32 --epochs 100 --data data/data.yaml --cfg models/custom_yolov5s.yaml --weights '' --name yolov5s_results --cache
end = datetime.now()

wandb: You can find your API key in your browser here: https://wandb.ai/authorize
wandb: Paste an API key from your profile and hit enter, or press ctrl+c to quit: .....
wandb: Appending key for api.wandb.ai to your netrc file: /root/.netrc
wandb: wandb version 0.12.16 is available! To upgrade, please run:
wandb: $ pip install wandb --upgrade
Syncing run warm-pond-1 to Weight & Biases (docs).
wandb: Currently logged in as: apurvtaneja (use `wandb login --relogin` to force relogin)
train: weights_, cfg=models/custom_yolov5s.yaml, data=data/data.yaml, hyp=data/hyps.scratch-low.yaml, epochs=100, batch_size=32, imgsz=640, rect=False, resume=False, noval=False, noautoanchor=False, noplots=False, evolve=None, bucket=True, cache=True, image_weights=False, device='cpu', multi_scale=False, single_cls=False, optimizer='SGD', sync_bn=False, workers=8, project='yolov5s/train', name=yolov5s_results, exist_ok=False, quad=False, cos_lr=False, label_smoothing=0.0, patience=100, freeze=[0], save_period=-1, local_rank=-1, entity=None, upload_dataset=False, bbox_interval=1, artifact_alias='latest'
remote: Enumerating objects: 17, done.
remote: Counting objects: 100% (17/17), done.
remote: Compressing objects: 100% (6/6), done.
remote: Total 17 (delta 11), reused 15 (delta 11), pack-reused 0
Unpacking objects: 100% (17/17), 16.27 KiB | 1.36 MiB/s, done.
From https://github.com/ultralytics/yolov5
  5e077bf1..5a1ef32 master      -> origin/master
 * [new branch]    rename/dataloaders -> origin/rename/dataloaders
github: ⚠️ YOLOv5 is out of date by 1 commit. Use `git pull` or `git clone https://github.com/ultralytics/yolov5` to update.
YOLOv5 ✨ v6.1-182-g5e077bf torch 1.9.1 CUDA:0 (Tesla P100-PCIE-16GB, 16281MiB)

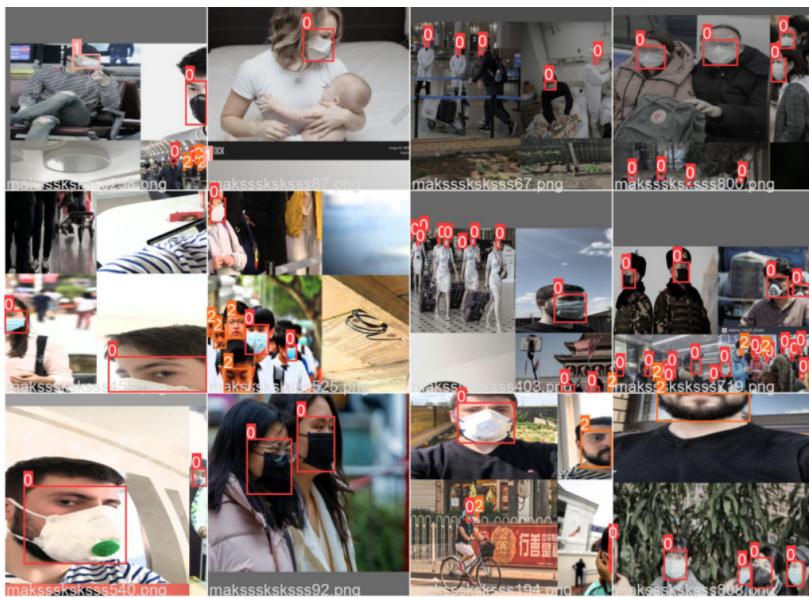
hyperparameters: lr=0.01, lrf=0.01, momentum=0.937, weight_decay=0.0005, warmup_epochs=3.0, warmup_momentum=0.8, warmup_bias_lr=0.1, box=0.05, cls=0.5, cls_pw=1.0, obj=1.0, obj_pw=1.0, iou_t=0.2, anchor_t=4.0, fl_gamma=0.0, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, degrees=0.0, translate=0.1, scale=0.5, shear=0.0, perspective=0.0, flipud=0.0, fliplr=0.5, mosaic=1.0, mixup=0.0, copy_paste=0.0
TensorBoard: Start with 'tensorboard --logdir runs/train', view at http://localhost:6006
wandb: wandb version 0.12.16 is available! To upgrade, please run:
wandb: $ pip install wandb --upgrade
wandb: Tracking run with wandb version 0.12.7
wandb: Syncing run yolov5s_results
wandb: ★ View project at https://wandb.ai/apurvtaneja/yolov5
wandb: 🌐 View run at https://wandb.ai/apurvtaneja/yolov5/runs/3lun3r7s
wandb: Run data is saved locally in /kaggle/working/yolov5/wandb/run-20220513_123045-3lun3r7s
wandb: Run 'wandb offline' to turn off syncing
```

Downloading <https://ultralytics.com/assets/Arial.ttf> to /root/.config/Ultralytics/Arial.ttf... 100% | 755k/755k [00:00<00:00, 95.3MB/s]

	Class	images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.621	0.37	0.319	0.133
15/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.05134	0.84423	0.01089	195	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.807	0.407	0.453	0.187
16/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.05132	0.04371	0.0105	167	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.765	0.391	0.436	0.167
17/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.0512	0.04102	0.009733	127	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.832	0.442	0.493	0.232
18/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04986	0.04151	0.009486	237	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.802	0.329	0.371	0.164
19/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04755	0.04216	0.009148	147	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.784	0.426	0.449	0.227
20/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.0455	0.04034	0.008998	136	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.86	0.432	0.492	0.229
21/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04696	0.04123	0.008875	169	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.809	0.438	0.477	0.243
22/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.0452	0.03832	0.008671	125	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.848	0.457	0.52	0.249
23/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04156	0.04006	0.007789	146	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.873	0.468	0.543	0.271
24/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04482	0.0384	0.008811	120	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.906	0.475	0.561	0.304
25/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04222	0.03947	0.008047	168	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.861	0.457	0.524	0.287
26/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04226	0.0398	0.008007	133	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.865	0.462	0.524	0.293
27/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04008	0.0363	0.007497	181	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.91	0.482	0.608	0.323
28/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04149	0.03722	0.007721	172	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.874	0.51	0.62	0.328
29/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04006	0.0371	0.00736	244	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.91	0.501	0.662	0.355
30/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03993	0.03386	0.00675	98	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.897	0.507	0.625	0.346
31/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.04062	0.03631	0.00704	88	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.913	0.508	0.621	0.342
32/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03886	0.03636	0.007041	127	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.911	0.523	0.683	0.376
33/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03785	0.03442	0.006686	244	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.926	0.516	0.644	0.368
34/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03712	0.0333	0.007056	146	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.906	0.53	0.668	0.397
35/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.0389	0.03643	0.006508	139	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.906	0.523	0.67	0.402
36/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03699	0.03592	0.006146	153	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.931	0.537	0.689	0.402
37/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03608	0.03615	0.006652	131	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.921	0.52	0.66	0.396
38/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03618	0.03336	0.006349	153	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.638	0.657	0.71	0.406
39/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03608	0.03516	0.006842	193	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.925	0.535	0.713	0.415
40/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03485	0.03359	0.0061	150	640: 100% ██████████	
	Class	Images	Labels	P	R	mAP@.5	mAP@
	all	725	3309	0.919	0.551	0.721	0.421

Epoch	gpu_mem	box	obj	cls	labels	img_size
41/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03545	0.03421	0.006312	131	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.597	0.691	0.718 0.433
Epoch	gpu_mem	box	obj	cls	labels	img_size
42/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03564	0.03457	0.006184	150	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.651	0.625	0.666 0.4
Epoch	gpu_mem	box	obj	cls	labels	img_size
43/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03405	0.03402	0.006213	168	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.908	0.544	0.642 0.385
Epoch	gpu_mem	box	obj	cls	labels	img_size
44/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03396	0.03255	0.006037	141	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.725	0.651	0.708 0.436
Epoch	gpu_mem	box	obj	cls	labels	img_size
45/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03466	0.03163	0.005667	127	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.655	0.665	0.703 0.421
Epoch	gpu_mem	box	obj	cls	labels	img_size
46/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03441	0.03355	0.005857	198	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.916	0.544	0.691 0.411
Epoch	gpu_mem	box	obj	cls	labels	img_size
47/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03514	0.03402	0.006523	138	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.71	0.661	0.714 0.435
Epoch	gpu_mem	box	obj	cls	labels	img_size
48/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03275	0.03218	0.005656	138	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.709	0.716	0.764 0.473
Epoch	gpu_mem	box	obj	cls	labels	img_size
49/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03414	0.03232	0.005627	183	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.679	0.698	0.749 0.464
Epoch	gpu_mem	box	obj	cls	labels	img_size
50/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.0334	0.03262	0.00512	129	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.691	0.685	0.74 0.459
Epoch	gpu_mem	box	obj	cls	labels	img_size
51/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.033	0.03277	0.005401	208	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.634	0.727	0.771 0.482
Epoch	gpu_mem	box	obj	cls	labels	img_size
52/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03191	0.03222	0.005259	171	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.755	0.714	0.759 0.48
Epoch	gpu_mem	box	obj	cls	labels	img_size
53/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03289	0.03247	0.005566	203	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.674	0.725	0.786 0.501
Epoch	gpu_mem	box	obj	cls	labels	img_size
54/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03238	0.03143	0.005294	114	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.707	0.713	0.758 0.48
Epoch	gpu_mem	box	obj	cls	labels	img_size
55/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03221	0.03081	0.005208	201	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.719	0.741	0.791 0.506
Epoch	gpu_mem	box	obj	cls	labels	img_size
56/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03201	0.03066	0.005219	140	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.729	0.709	0.775 0.484
Epoch	gpu_mem	box	obj	cls	labels	img_size
57/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03104	0.03056	0.005232	123	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.691	0.743	0.768 0.485
Epoch	gpu_mem	box	obj	cls	labels	img_size
58/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03126	0.02997	0.005378	126	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.76	0.726	0.79 0.505
Epoch	gpu_mem	box	obj	cls	labels	img_size
59/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03208	0.03239	0.005195	185	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.705	0.738	0.802 0.512
Epoch	gpu_mem	box	obj	cls	labels	img_size
60/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03142	0.03231	0.005353	204	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.718	0.75	0.801 0.514
Epoch	gpu_mem	box	obj	cls	labels	img_size
61/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03153	0.03209	0.005051	121	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.784	0.733	0.782 0.499
Epoch	gpu_mem	box	obj	cls	labels	img_size
62/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.03102	0.03139	0.005179	142	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.761	0.753	0.814 0.525
Epoch	gpu_mem	box	obj	cls	labels	img_size
63/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.0313	0.03155	0.004688	120	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.733	0.735	0.781 0.509
Epoch	gpu_mem	box	obj	cls	labels	img_size
64/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.02996	0.03032	0.004699	178	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.77	0.727	0.786 0.513
Epoch	gpu_mem	box	obj	cls	labels	img_size
65/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.02967	0.02967	0.004454	167	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.804	0.755	0.82 0.541
Epoch	gpu_mem	box	obj	cls	labels	img_size
66/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.02989	0.03197	0.004279	203	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@
	all	725	3309	0.732	0.74	0.785 0.517
Epoch	gpu_mem	box	obj	cls	labels	img_size
67/99	gpu_mem	box	obj	cls	labels	img_size
	8.23G	0.02988	0.03043	0.004625	176	640: 100% ██████████
	Class	Images	Labels	P	R	mAP@.5 mAP@

	all	725	3309	0.774	0.779	0.834	0.556
68/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.03045	0.03098	0.00489	158	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.738	0.781	0.815	0.542
69/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02944	0.03001	0.004481	184	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.772	0.788	0.837	0.549
70/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02966	0.03097	0.00446	155	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.74	0.788	0.842	0.552
71/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02925	0.02825	0.004501	127	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.799	0.759	0.822	0.542
72/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02895	0.0282	0.00462	169	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.784	0.808	0.839	0.561
73/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02839	0.02813	0.004591	110	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.831	0.782	0.839	0.555
74/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.0292	0.03155	0.004089	122	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.798	0.805	0.852	0.565
75/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02842	0.02909	0.003941	149	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.815	0.781	0.836	0.559
76/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02898	0.02894	0.004157	110	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.775	0.781	0.847	0.564
77/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02825	0.02957	0.00412	179	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.766	0.778	0.84	0.56
78/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02863	0.02788	0.003973	133	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.813	0.784	0.847	0.569
79/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02842	0.02786	0.004205	203	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.813	0.765	0.837	0.56
80/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02855	0.02909	0.003749	156	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.826	0.809	0.862	0.581
81/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02801	0.02828	0.003859	129	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.791	0.797	0.852	0.575
82/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02819	0.02857	0.004236	159	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.841	0.836	0.872	0.588
83/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02724	0.02761	0.00349	103	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.857	0.818	0.866	0.597
84/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02792	0.02872	0.003639	149	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.816	0.823	0.871	0.597
85/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02744	0.02897	0.003624	135	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.807	0.806	0.854	0.587
86/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02782	0.02886	0.004152	137	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.863	0.811	0.865	0.595
87/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02793	0.02855	0.004177	136	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.847	0.811	0.867	0.596
88/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02791	0.02882	0.004122	98	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.833	0.811	0.873	0.598
89/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02733	0.02777	0.004183	269	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.824	0.794	0.849	0.585
90/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02731	0.02904	0.003841	150	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.846	0.797	0.868	0.6
91/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02776	0.02816	0.003701	160	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.872	0.811	0.873	0.606
92/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.0268	0.0287	0.003333	148	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.851	0.807	0.872	0.601
93/99	gpu_mem	box	obj	cls	labels	img_size	
	8.23G	0.02726	0.02772	0.00373	167	640: 100% ████	
	Class	Images	Labels	P	R	mAP@.5 mAP@	
	all	725	3309	0.851	0.804	0.877	0.606
Epoch	gpu mem	box	obj	cls	labels	img size	



+ Code + Markdown

Evaluation Model

[39]:

```
!python detect.py --source data/test/images/ --weight runs/train/yolov5s_results/weights/best.pt --name expTestImage --conf 0.4

detect: weights=['runs/train/yolov5s_results/weights/best.pt'], source=data/test/images/, data=data/coco128.yaml, imgsz=[640, 640], conf_thres=0.4, iou_thres=0.45, max_det=1000, device=, view_img=False, save_txt=False, save_conf=False, save_crop=False, nosave=False, classes=None, agnostic_nms=False, augment=False, visualize=False, update=False, project=runs/detect, name=expTestImage, exist_ok=False, line_thickness=3, hide_labels=False, hide_conf=False, half=False, dnn=False
YOLOv5 🚀 v6.1-182-g5e077bf torch 1.9.1 CUDA:0 (Tesla P100-PCIE-16GB, 16281MiB)

Fusing layers...
custom_YOLOv5s summary: 232 layers, 7251912 parameters, 0 gradients, 16.8 GFLOPs
image 1/38 /kaggle/working/yolov5/data/test/images/makssksksss104.png: 480x640 3 with_masks, 6 without_masks, Done. (0.013s)
image 2/38 /kaggle/working/yolov5/data/test/images/makssksksss113.png: 480x640 3 with_masks, Done. (0.009s)
image 3/38 /kaggle/working/yolov5s/data/test/images/makssksksss120.png: 480x640 1 with_mask, Done. (0.009s)
image 4/38 /kaggle/working/yolov5s/data/test/images/makssksksss156.png: 480x640 7 with_masks, 7 without_masks, Done. (0.009s)
image 5/38 /kaggle/working/yolov5s/data/test/images/makssksksss160.png: 480x640 5 with_masks, Done. (0.009s)
image 6/38 /kaggle/working/yolov5s/data/test/images/makssksksss167.png: 480x640 4 with_masks, Done. (0.009s)
image 7/38 /kaggle/working/yolov5s/data/test/images/makssksksss226.png: 480x640 1 with_mask, Done. (0.009s)
image 8/38 /kaggle/working/yolov5s/data/test/images/makssksksss261.png: 480x640 3 with_masks, 3 without_masks, Done. (0.009s)
image 9/38 /kaggle/working/yolov5s/data/test/images/makssksksss320.png: 480x640 3 with_masks, Done. (0.009s)
image 10/38 /kaggle/working/yolov5s/data/test/images/makssksksss323.png: 480x640 1 with_mask, Done. (0.011s)
image 11/38 /kaggle/working/yolov5s/data/test/images/makssksksss323.png: 480x640 1 with_mask, Done. (0.009s)
image 12/38 /kaggle/working/yolov5s/data/test/images/makssksksss338.png: 480x640 7 with_masks, Done. (0.009s)
image 13/38 /kaggle/working/yolov5s/data/test/images/makssksksss342.png: 480x640 10 with_masks, 1 without_mask, Done. (0.010s)
image 14/38 /kaggle/working/yolov5s/data/test/images/makssksksss344.png: 480x640 4 with_masks, Done. (0.011s)
image 15/38 /kaggle/working/yolov5s/data/test/images/makssksksss359.png: 480x640 19 with_masks, 1 without_mask, Done. (0.009s)
image 16/38 /kaggle/working/yolov5s/data/test/images/makssksksss365.png: 480x640 7 with_masks, Done. (0.009s)
image 17/38 /kaggle/working/yolov5s/data/test/images/makssksksss389.png: 480x640 1 with_mask, Done. (0.009s)
image 18/38 /kaggle/working/yolov5s/data/test/images/makssksksss412.png: 480x640 4 with_masks, Done. (0.009s)
image 19/38 /kaggle/working/yolov5s/data/test/images/makssksksss445.png: 480x640 9 with_masks, 1 without_mask, Done. (0.009s)
image 20/38 /kaggle/working/yolov5s/data/test/images/makssksksss453.png: 480x640 8 with_masks, 9 without_masks, Done. (0.009s)
image 21/38 /kaggle/working/yolov5s/data/test/images/makssksksss463.png: 480x640 Done. (0.009s)
image 22/38 /kaggle/working/yolov5s/data/test/images/makssksksss467.png: 480x640 5 with_masks, 1 without_mask, Done. (0.010s)
image 23/38 /kaggle/working/yolov5s/data/test/images/makssksksss509.png: 480x640 1 with_mask, Done. (0.009s)
image 24/38 /kaggle/working/yolov5s/data/test/images/makssksksss547.png: 480x640 2 with_masks, Done. (0.009s)
image 25/38 /kaggle/working/yolov5s/data/test/images/makssksksss552.png: 480x640 1 with_mask, Done. (0.012s)
image 26/38 /kaggle/working/yolov5s/data/test/images/makssksksss556.png: 480x640 10 with_masks, 1 without_mask, Done. (0.009s)
image 27/38 /kaggle/working/yolov5s/data/test/images/makssksksss587.png: 480x640 2 with_masks, Done. (0.009s)
image 28/38 /kaggle/working/yolov5s/data/test/images/makssksksss606.png: 480x640 2 with_masks, 1 without_mask, Done. (0.009s)
image 29/38 /kaggle/working/yolov5s/data/test/images/makssksksss627.png: 480x640 7 with_masks, 6 without_masks, Done. (0.009s)
image 30/38 /kaggle/working/yolov5s/data/test/images/makssksksss650.png: 480x640 1 with_mask, Done. (0.010s)
image 31/38 /kaggle/working/yolov5s/data/test/images/makssksksss651.png: 480x640 1 with_mask, Done. (0.009s)
image 32/38 /kaggle/working/yolov5s/data/test/images/makssksksss705.png: 480x640 18 with_masks, Done. (0.016s)
image 33/38 /kaggle/working/yolov5s/data/test/images/makssksksss71.png: 480x640 4 with_masks, 2 without_masks, Done. (0.015s)
image 34/38 /kaggle/working/yolov5s/data/test/images/makssksksss725.png: 480x640 1 with_mask, Done. (0.018s)
image 35/38 /kaggle/working/yolov5s/data/test/images/makssksksss756.png: 480x640 1 with_mask, Done. (0.016s)
image 36/38 /kaggle/working/yolov5s/data/test/images/makssksksss761.png: 480x640 1 mask_woreed_incorrect, Done. (0.014s)
image 37/38 /kaggle/working/yolov5s/data/test/images/makssksksss832.png: 480x640 Done. (0.018s)
image 38/38 /kaggle/working/yolov5s/data/test/images/makssksksss90.png: 480x640 10 with_masks, Done. (0.022s)
Speed: 0.6ms pre-process, 10.9ms inference, 1.4ms NMS per image at shape (1, 3, 640, 640)
Results saved to runs/detect/expTestImage
```

+ Code + Markdown

[40]:

```
color_dict = {
    'with_mask': (0, 255, 0),
    'mask_woreed_incorrect': (0, 0, 255),
    'without_mask': (255, 0, 0)
}
```

[45]:

```
def show_image(img_id):
    df_image = df[df.file==img_id]
    df_image[['xmin', 'ymin', 'xmax', 'ymax']] = df_image[['xmin', 'ymin', 'xmax', 'ymax']].astype('int64')
    path = 'data/test/images/' + img_id + '.png'
    img = plt.imread(path)

    img = img.copy()

    for index in range(len(df_image)):
        row = df_image.iloc[index]
        cv2.rectangle(img,
                      (row['xmin'], row['ymin']),
                      (row['xmax'], row['ymax']),
                      color_dict[row['label']], 2)
```

```
(row[ 'xmax' ], row[ 'ymax' ]),
color=color_dict[row[ 'name' ]],
thickness=2)

img_pred = plt.imread('runs/detect/expTestImage/' + img_id + '.png')
# =====
plt.figure(figsize=(14,17))

plt.subplot(1,2,1)
plt.imshow(img)
plt.axis('off')
plt.title('Image with Truth Box')

plt.subplot(1,2,2)
plt.imshow(img_pred)
plt.axis('off')
plt.title('Image with Predicted Box')
```

+ Code + Markdown

```
show_image("makssksksss466")
show_image("makssksksss164")
plt.show()
```

[47]:

```
%cd ../
```

/kaggle/working

+ Code + Markdown

[]:

```
!python yolov5/detect.py --source ./input/facemaskdetectionvideo/Wear-Mask.mp4 --weight yolov5/runs/train/yolov5s_results/weights/best.pt --name video --conf 0.
```

[Download Test Video](#)

End :)



Console