Evalution Result

YOLO-Empty	train	validation	test
mAP50	0.94	0.994	0.993
mAP50-95	0.886	0.789	0.791
Precision	0.997	0.989	0.989
Recall	0.995	0.993	0.996

Mount the google drive

```
1 from google.colab import drive
2 drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
1 %cd /content/drive/MyDrive/42028_Assessment3
```

```
/content/drive/MyDrive/42028_Assessment3
```

```
1 ls
```

```
 dataset/                                pre_seat.ipynb
 dataset_empty/                          ssd_coco_dataset/
 dataset_empty_pascal/                   unzip.ipynb
 experiment/                             Video_Inference/
 obj_train_data/                         yolo_angle_3_1_standing.zip
 original/                              'yolo_empty(Data enhancement).ipynb'
 pre_dataset/                            yolo_empty.ipynb
 pre_dataset_angle3standing/            'yolo_formal(Data_enhancement).ipynb'
'pre_dataset_angle3standing\test.txt'    yolo_formal.ipynb
'pre_dataset_angle3standing\train.txt'   YOLO_STANDING/
'pre_dataset_angle3standing\val.txt'     yolov5/
```

```
1 !git clone https://github.com/ultralytics/yolov5.git # Import the existing yolov5 model
```

```
Cloning into 'yolov5'...
remote: Enumerating objects: 15639, done.
remote: Counting objects: 100% (246/246), done.
remote: Compressing objects: 100% (177/177), done.
remote: Total 15639 (delta 121), reused 142 (delta 69), pack-reused 15393
Receiving objects: 100% (15639/15639), 14.65 MiB | 10.09 MiB/s, done.
Resolving deltas: 100% (10649/10649), done.
```

```
1 ls
```

```
 dataset/                                'pre_dataset_angle3standing\val.txt'
 dataset_empty/                          pre_seat.ipynb
 dataset_empty_pascal/                   unzip.ipynb
 experiment/                             Video_Inference/
 obj_train_data/                         yolo_angle_3_1_standing.zip
 original/                               yolo_empty.ipynb
 pre_dataset/                            yolo_formal.ipynb
 pre_dataset_angle3standing/             YOLO_STANDING/
'pre_dataset_angle3standing\test.txt'    yolov5/
'pre_dataset_angle3standing\train.txt'
```

```
1 %cd /content/drive/MyDrive/42028_Assessment3/yolov5
```

```
/content/drive/MyDrive/42028_Assessment3/yolov5
```

```
1 ls
```

```
 1_data_yaml             DetectionResult2.webm   README.zh-CN.md
 a_data_yaml             DetectionResult.webm    requirements.txt
 adata_yaml              detect.py               runs/
 benchmarks.py           empty1.pt               segment/
 CITATION.cff            empty.pt                setup.cfg
 classify/               export.py               train.py
 CONTRIBUTING.md         hubconf.py              tutorial.ipynb
 data/                   LICENSE                 utils/
 data_seat.yaml          models/                 val.py
 data_standing.yaml      new_data_yaml          'yolov5m (1).pt'
 data.yaml               new_train_yaml          yolov5m.pt
 data_yaml               __pycache__/            yolov5s.pt
 DetectionResult1.webm   README.md               yolov5s-seg.pt
```

```
!pip install -r requirements.txt # Import package
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Collecting gitpython>=3.1.30 (from -r requirements.txt (line 5))
  Downloading GitPython-3.1.31-py3-none-any.whl (184 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 184.3/184.3 kB 5.4 MB/s eta 0:00:00
Requirement already satisfied: matplotlib>=3.3 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line
Requirement already satisfied: numpy>=1.18.5 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 7
Requirement already satisfied: opencv-python>=4.1.1 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt
Requirement already satisfied: Pillow>=7.1.2 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 9
Requirement already satisfied: psutil in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 10)) (5.
Requirement already satisfied: PyYAML>=5.3.1 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 1
Requirement already satisfied: requests>=2.23.0 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (lin
Requirement already satisfied: scipy>=1.4.1 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 13
Collecting thop>=0.1.1 (from -r requirements.txt (line 14))
  Downloading thop-0.1.1.post2209072238-py3-none-any.whl (15 kB)
Requirement already satisfied: torch>=1.7.0 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 15
Requirement already satisfied: torchvision>=0.8.1 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (l
Requirement already satisfied: tqdm>=4.64.0 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 17
Requirement already satisfied: pandas>=1.1.4 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line 2
Requirement already satisfied: seaborn>=0.11.0 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (line
Requirement already satisfied: setuptools>=65.5.1 in /usr/local/lib/python3.10/dist-packages (from -r requirements.txt (l
Collecting gitdb<5,>=4.0.1 (from gitpython>=3.1.30->-r requirements.txt (line 5))
  Downloading gitdb-4.0.10-py3-none-any.whl (62 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 62.7/62.7 kB 8.7 MB/s eta 0:00:00
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3->-r requ
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3->-r requirem
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3->-r req
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3->-r req
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3->-r requi
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3->-r requ
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3->-r
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->-
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->-r r
Requirement already satisfied: charset-normalizer~=2.0.0 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->-r require
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from torch>=1.7.0->-r requirements.tx
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.10/dist-packages (from torch>=1.7.0->-r requir
Requirement already satisfied: sympy in /usr/local/lib/python3.10/dist-packages (from torch>=1.7.0->-r requirements.txt (
Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=1.7.0->-r requirements.tx
Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packages (from torch>=1.7.0->-r requirements.txt
Requirement already satisfied: triton==2.0.0 in /usr/local/lib/python3.10/dist-packages (from torch>=1.7.0->-r requiremen
Requirement already satisfied: cmake in /usr/local/lib/python3.10/dist-packages (from triton==2.0.0->torch>=1.7.0->-r req
Requirement already satisfied: lit in /usr/local/lib/python3.10/dist-packages (from triton==2.0.0->torch>=1.7.0->-r requi
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.1.4->-r requiremen
Collecting smmap<6,>=3.0.1 (from gitdb<5,>=4.0.1->gitpython>=3.1.30->-r requirements.txt (line 5))
  Downloading smmap-5.0.0-py3-none-any.whl (24 kB)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.7->matplotlib
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from jinja2->torch>=1.7.0->-r
Requirement already satisfied: mpmath>=0.19 in /usr/local/lib/python3.10/dist-packages (from sympy->torch>=1.7.0->-r requ
Installing collected packages: smmap, gitdb, gitpython, thop
Successfully installed gitdb-4.0.10 gitpython-3.1.31 smmap-5.0.0 thop-0.1.1.post2209072238
```

Setup Dataset Configuration (data.yaml)

Setup Dataset Configuration (Data.yaml)

```
#@title Setup Dataset Configuration (Data.yaml)
number_of_classes = 1
train_data_dir = "/content/drive/MyDrive/42028_Assessment3/dataset_empty/train" #@param {type:"string"}
val_data_dir = "/content/drive/MyDrive/42028_Assessment3/dataset_empty/valid" #@param {type:"string"}
test_data_dir = "/content/drive/MyDrive/42028_Assessment3/dataset_empty/test" #@param {type:"string"}

class_names = ["Empty_Seat"] #@param {type:"raw"}
with open('adata_yaml', 'w+') as file:
    file.write(
        f"""
        train: {train_data_dir}
        val: {val_data_dir}
        test: {test_data_dir}
        nc: {number_of_classes}
        names: {class_names}
        """
    )
```

train_data_dir: "/content/drive/MyDrive/42028_Assessm"

val_data_dir: "/content/drive/MyDrive/42028_Assessmen"

test_data_dir: "/content/drive/MyDrive/42028_Assessme"

class_names: ["Empty_Seat"]

Setup Training YAML File

```
#@title Setup Training YAML File
# Choose yolov5m as transfer learning
number_of_classes = 1 #@param {type:"integer"}
with open('new_train_yaml', 'w+') as file:
    file.write(
```

number_of_classes: 1

```
        f"""
        # parameters
        nc: {number_of_classes}  # number of classes
        depth_multiple: 0.67  # model depth multiple
        width_multiple: 0.75  # layer channel multiple
        anchors:
          - [10,13, 16,30, 33,23]  # P3/8
          - [30,61, 62,45, 59,119]  # P4/16
          - [116,90, 156,198, 373,326]  # P5/32

        # YOLOv5 v6.0 backbone
        backbone:
          # [from, number, module, args]
          [[-1, 1, Conv, [64, 6, 2, 2]],  # 0-P1/2
          [-1, 1, Conv, [128, 3, 2]],  # 1-P2/4
          [-1, 3, C3, [128]],
          [-1, 1, Conv, [256, 3, 2]],  # 3-P3/8
          [-1, 6, C3, [256]],
          [-1, 1, Conv, [512, 3, 2]],  # 5-P4/16
          [-1, 9, C3, [512]],
          [-1, 1, Conv, [1024, 3, 2]],  # 7-P5/32
          [-1, 3, C3, [1024]],
          [-1, 1, SPPF, [1024, 5]],  # 9
          ]

        # YOLOv5 v6.0 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, C3, [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, C3, [256, False]],  # 17 (P3/8-small)

          [-1, 1, Conv, [256, 3, 2]],
          [[-1, 14], 1, Concat, [1]],  # cat head P4
          [-1, 3, C3, [512, False]],  # 20 (P4/16-medium)

          [-1, 1, Conv, [512, 3, 2]],
          [[-1, 10], 1, Concat, [1]],  # cat head P5
          [-1, 3, C3, [1024, False]],  # 23 (P5/32-large)

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

Training with YOLOv5

```
from datetime import datetime # To get model training time
import matplotlib.pyplot as plt # Import the pyplot module from the matplotlib library for drawing graphs

start = datetime.now() # Get the current time of start
!python train.py --img 416 --batch 32 --epochs 50 --hyp "/content/drive/MyDrive/42028_Assessment3/yolov5/data/hyp.scratch.y
end = datetime.now() # Get the current time of end
print('Trainine time:', end - start)
```

```
      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      45/49       5.3G    0.02798    0.03878          0        384        416: 100% 65/65 [06:16<00:00,  5.80s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:05<00:00,  1.13s/i
                   all        258       3096      0.998      0.997      0.994      0.881

      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      46/49       5.3G    0.02761    0.03834          0        440        416: 100% 65/65 [06:18<00:00,  5.83s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:07<00:00,  1.41s/i
                   all        258       3096      0.997      0.995      0.994      0.886

      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      47/49       5.3G    0.02779     0.0379          0        398        416: 100% 65/65 [05:59<00:00,  5.54s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:04<00:00,  1.01it/
                   all        258       3096      0.996      0.998      0.994      0.871

      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      48/49       5.3G    0.02737    0.03717          0        468        416: 100% 65/65 [06:04<00:00,  5.60s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:04<00:00,  1.01it/
                   all        258       3096      0.998      0.999      0.994      0.872

      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      49/49       5.3G    0.02739    0.03764          0        394        416: 100% 65/65 [05:56<00:00,  5.49s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:05<00:00,  1.14s/i
                   all        258       3096      0.999      0.999      0.994      0.875

50 epochs completed in 5.424 hours.
Optimizer stripped from runs/train/exp17/weights/last.pt, 42.1MB
Optimizer stripped from runs/train/exp17/weights/best.pt, 42.1MB

Validating runs/train/exp17/weights/best.pt...
Fusing layers...
new_train_yaml summary: 212 layers, 20852934 parameters, 0 gradients, 47.9 GFLOPs
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:29<00:00,  5.81s/i
                   all        258       3096      0.997      0.995      0.994      0.886
Results saved to runs/train/exp17
Trainine time: 5:26:56.351582
```

Show the result of train and validation

```
import matplotlib.pyplot as plt
f = plt.figure(figsize=(20, 16))
ax1 = f.add_subplot(1,2,1)
ax1.imshow(plt.imread("/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/train_batch0.jpg"))
ax1.set_title('Train',fontsize = 14)
ax2 = f.add_subplot(1,2,2)
ax2.imshow(plt.imread("/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/val_batch0_pred.jpg"))
ax2.set_title('Validation',fontsize = 14)
```

```
Text(0.5, 1.0, 'Validation')
```

Get test set results


```
# Get the best results from the train and test the test dataset
!python detect.py --weights /content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/weights/best.pt --source /cont
```

```
image 204/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_5474.jpg: 384x640 12 Empty_Seats,
image 205/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_5479.jpg: 384x640 12 Empty_Seats,
image 206/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_5480.jpg: 384x640 12 Empty_Seats,
image 207/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_5486.jpg: 384x640 12 Empty_Seats,
image 208/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000005.PNG: 384x640 11 Empty_Seats
image 209/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000018.PNG: 384x640 11 Empty_Seats
image 210/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000052.PNG: 384x640 11 Empty_Seats
image 211/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000056.PNG: 384x640 11 Empty_Seats
image 212/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000063.PNG: 384x640 11 Empty_Seats
image 213/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000077.PNG: 384x640 11 Empty_Seats
image 214/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000086.PNG: 384x640 11 Empty_Seats
image 215/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000099.PNG: 384x640 11 Empty_Seats
image 216/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000108.PNG: 384x640 11 Empty_Seats
image 217/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000115.PNG: 384x640 11 Empty_Seats
image 218/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000116.PNG: 384x640 11 Empty_Seats
image 219/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000117.PNG: 384x640 11 Empty_Seats
image 220/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000131.PNG: 384x640 11 Empty_Seats
image 221/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000152.PNG: 384x640 11 Empty_Seats
image 222/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000154.PNG: 384x640 11 Empty_Seats
image 223/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000170.PNG: 384x640 11 Empty_Seats
image 224/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000172.PNG: 384x640 11 Empty_Seats
image 225/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000181.PNG: 384x640 12 Empty_Seats
image 226/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000184.PNG: 384x640 12 Empty_Seats
image 227/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000195.PNG: 384x640 11 Empty_Seats
image 228/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000211.PNG: 384x640 11 Empty_Seats
image 229/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000217.PNG: 384x640 12 Empty_Seats
image 230/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000218.PNG: 384x640 13 Empty_Seats
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image 233/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000244.PNG: 384x640 11 Empty_Seats
image 234/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000253.PNG: 384x640 11 Empty_Seats
image 235/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000257.PNG: 384x640 12 Empty_Seats
image 236/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000260.PNG: 384x640 12 Empty_Seats
image 237/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000280.PNG: 384x640 13 Empty_Seats
image 238/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000308.PNG: 384x640 12 Empty_Seats
image 239/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000309.PNG: 384x640 11 Empty_Seats
image 240/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000315.PNG: 384x640 11 Empty_Seats
image 241/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000350.PNG: 384x640 12 Empty_Seats
image 242/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000352.PNG: 384x640 11 Empty_Seats
image 243/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000359.PNG: 384x640 11 Empty_Seats
image 244/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000362.PNG: 384x640 11 Empty_Seats
image 245/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000366.PNG: 384x640 12 Empty_Seats
image 246/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000371.PNG: 384x640 12 Empty_Seats
image 247/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000372.PNG: 384x640 12 Empty_Seats
image 248/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000381.PNG: 384x640 11 Empty_Seats
image 249/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000389.PNG: 384x640 12 Empty_Seats
image 250/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000400.PNG: 384x640 12 Empty_Seats
image 251/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000406.PNG: 384x640 11 Empty_Seats
image 252/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000415.PNG: 384x640 11 Empty_Seats
image 253/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000428.PNG: 384x640 12 Empty_Seats
image 254/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000430.PNG: 384x640 11 Empty_Seats
image 255/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000432.PNG: 384x640 12 Empty_Seats
image 256/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000435.PNG: 384x640 12 Empty_Seats
image 257/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000438.PNG: 384x640 12 Empty_Seats
image 258/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000448.PNG: 384x640 12 Empty_Seats
image 259/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/frame_000455.PNG: 384x640 13 Empty_Seats
Speed: 0.5ms pre-process, 9.0ms inference, 1.4ms NMS per image at shape (1, 3, 640, 640)
Results saved to runs/detect/exp18
```
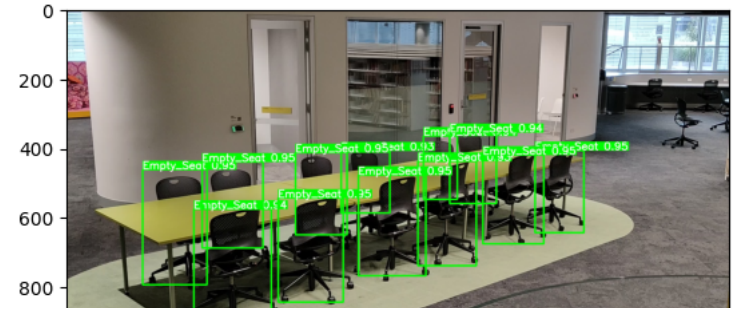

Show the result of test

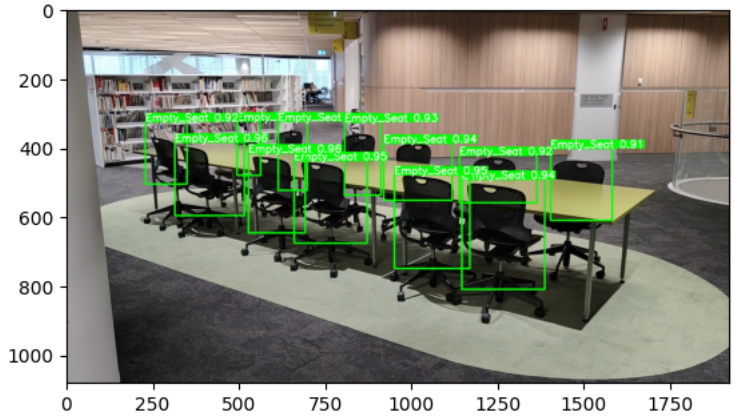
```
import cv2
import matplotlib.pyplot as plt
test_img = plt.imread("/content/drive/MyDrive/42028_Assessment3/yolov5/runs/detect/exp18/empty_2001.jpg")
resize_img = cv2.resize(test_img, (20, 20))
plt.imshow(test_img)
```

```
<matplotlib.image.AxesImage at 0x7fe3c7866ce0>
```



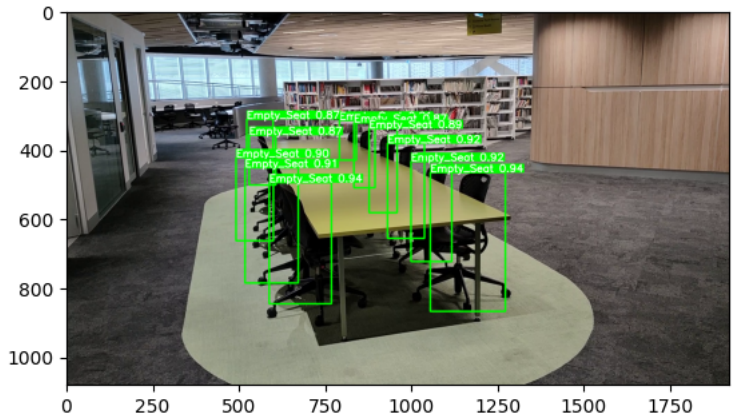
```
1 test_img2 = plt.imread("/content/drive/MyDrive/42028_Assessment3/yolov5/runs/detect/exp18/empty_5052.jpg")
2 resize_img = cv2.resize(test_img2, (20, 20))
3 plt.imshow(test_img2)
```

```
<matplotlib.image.AxesImage at 0x7fe3c77861a0>
```



```
1 test_img3 = plt.imread("/content/drive/MyDrive/42028_Assessment3/yolov5/runs/detect/exp18/frame_000359.PNG")
2 resize_img = cv2.resize(test_img3, (20, 20))
3 plt.imshow(test_img3)
```

```
<matplotlib.image.AxesImage at 0x7fe3c7620220>
```

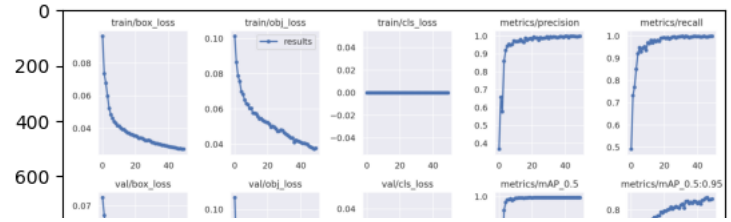


Display performance analysis

Show Train and Validation Visualization Result

```
1 from PIL import Image
2 image = Image.open('/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/results.png') # Change 'exp' to the la
3 #resize_img = cv2.resize(image, (20, 20))
4 plt.imshow(image)
```

```
<matplotlib.image.AxesImage at 0x7fe3c6c90430>
```



Show Validation Reselt

```
1 !python val.py --weights /content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/weights/best.pt --data data.yaml
```

```
val: data=data.yaml, weights=['/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/weights/best.pt'], batch_
requirements: /content/drive/MyDrive/42028_Assessment3/requirements.txt not found, check failed.
YOLOv5 🚀 v7.0-160-g867f7f0 Python-3.10.11 torch-2.0.1+cu118 CUDA:0 (Tesla V100-SXM2-16GB, 16151MiB)

Fusing layers...
new_train_yaml summary: 212 layers, 20852934 parameters, 0 gradients, 47.9 GFLOPs
Downloading https://ultralytics.com/assets/Arial.ttf to /root/.config/Ultralytics/Arial.ttf...
100% 755k/755k [00:00<00:00, 17.7MB/s]
val: Scanning /content/drive/MyDrive/42028_Assessment3/dataset_empty/valid/labels.cache... 258 images, 0 backgrounds, 0 c
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 9/9 [00:33<00:00,  3.70s/i
                   all        258       3096      0.989      0.993      0.994      0.789
Speed: 0.5ms pre-process, 4.5ms inference, 7.9ms NMS per image at shape (32, 3, 640, 640)
Results saved to runs/val/exp10
```

Show Test Result

- The val.py is designed to evaluate the performance of the validation dataset by default. Therefore, to evaluate the performance of the test datasets, we need to modify the new_data_yaml file and rewrite the paths for the test datasets to point to the validation dataset path.

Setup Dataset Configuration (Data.yaml)

```
1 #@title Setup Dataset Configuration (Data.yaml)
2 number_of_classes = 1
3 train_data_dir = "/content/drive/MyDrive/42028_Assessment3/dataset_empty/train" #@param {type:"string"}
4 val_data_dir = "/content/drive/MyDrive/42028_Assessment3/dataset_empty/test" #@param {type:"string"}
5 test_data_dir = "/content/drive/MyDrive/42028_Assessment3/dataset_empty/test" #@param {type:"string"}
6
7 class_names = ["Empty_Seat"] #@param {type:"raw"}
8 with open('data_yaml', 'w+') as file:
9     file.write(
10         f"""
11         train: {train_data_dir}
12         val: {val_data_dir}
13         test: {test_data_dir}
14         nc: {number_of_classes}
15         names: {class_names}
16         """
17     )
```

train_data_dir: "/content/drive/MyDrive/42028_Assessm"

val_data_dir: "/content/drive/MyDrive/42028_Assessmen"

test_data_dir: "/content/drive/MyDrive/42028_Assessme"

class_names: ["Empty_Seat"]

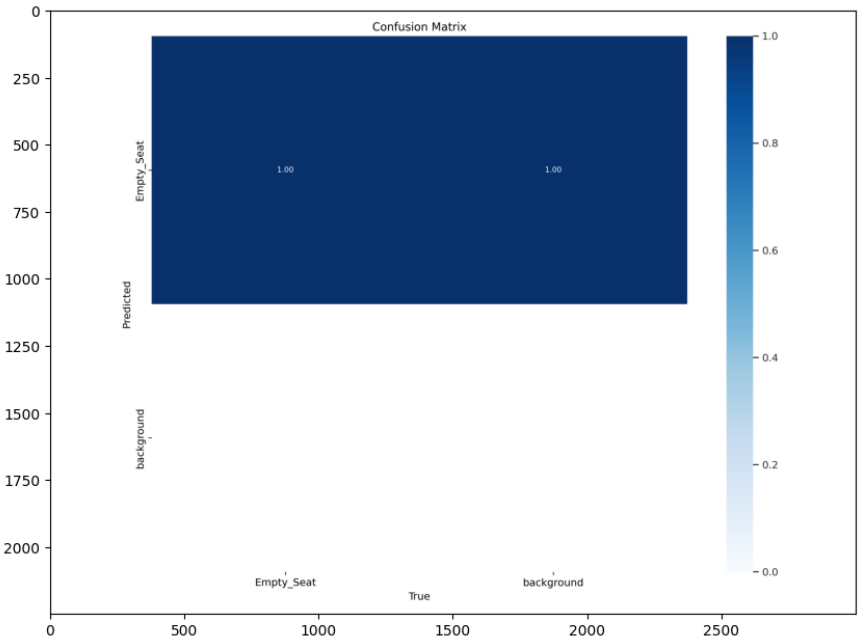
```
1 # Change the path of the validation in new_data_yaml to the path of the test dataset and see how the result of test dataset
2 !python val.py --weights /content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/weights/best.pt --data data_yaml
```

```
val: data=data_yaml, weights=['/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/weights/best.pt'], batch_
requirements: /content/drive/MyDrive/42028_Assessment3/requirements.txt not found, check failed.
YOLOv5 🚀 v7.0-160-g867f7f0 Python-3.10.11 torch-2.0.1+cu118 CUDA:0 (Tesla V100-SXM2-16GB, 16151MiB)

Fusing layers...
new_train_yaml summary: 212 layers, 20852934 parameters, 0 gradients, 47.9 GFLOPs
val: Scanning /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/labels.cache... 258 images, 1 backgrounds, 0 cc
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 9/9 [00:26<00:00,  2.91s/i
                   all        259       3096      0.989      0.996      0.993      0.791
Speed: 0.3ms pre-process, 4.2ms inference, 7.1ms NMS per image at shape (32, 3, 640, 640)
Results saved to runs/val/exp12
```

Confunsion Matrix - Train

```
1 import matplotlib.pyplot as plt
2 import matplotlib.image as image
3
4 img = image.imread('/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp17/confusion_matrix.png')
5 fig = plt.figure(figsize=(10, 10), dpi=100)
```

```
6 plt.imshow(img)
7 plt.show()
```



Confusion Matrix - Validation

```
1 import matplotlib.pyplot as plt
2 import matplotlib.image as image
3
4 img = image.imread('/content/drive/MyDrive/42028_Assessment3/yolov5/runs/val/exp10/confusion_matrix.png')
5 fig = plt.figure(figsize=(10, 10), dpi=100)
6 plt.imshow(img)
7 plt.show()
```

Confusion Matrix - Test

```
1 import matplotlib.pyplot as plt
2 import matplotlib.image as image
3
4 img = image.imread('/content/drive/MyDrive/42028_Assessment3/yolov5/runs/val/exp12/confusion_matrix.png')
5 fig = plt.figure(figsize=(10, 10), dpi=100)
6 plt.imshow(img)
7 plt.show()
```