Evalution Result

YOLO	train	validation	test
mAP50	0.994	0.994	0.994
mAP50-95	0.927	0.842	0.843
Precision	0.999	0.999	0.995
Recall	0.999	0.997	0.998

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_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 !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
```

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

```
1 !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 21.0 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 9.4 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('data_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 = 2 #@param {type:"integer"}
with open('new_train_yaml', 'w+') as file:
    file.write(
        f"""
        # parameters
        nc: {number_of_classes}  # number of classes
        depth_multiple: 0.67  # model depth multiple
        width_multiple: 0.75  # layer channel multiple
```

number_of_classes: 2

```
        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 --data data_yaml --weights yolov5m.pt --cfg new_train_yaml # The input im
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
      46/49       5.3G     0.0248    0.03133          0        440        416: 100% 65/65 [05:54<00:00,  5.45s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:04<00:00,  1.15it/
                   all        258       3096      0.999      0.999      0.994      0.908

      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      47/49       5.3G    0.02486    0.03083          0        398        416: 100% 65/65 [05:54<00:00,  5.45s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:04<00:00,  1.09it/
                   all        258       3096      0.999      0.999      0.994      0.921

      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      48/49       5.3G    0.02452    0.03007          0        468        416: 100% 65/65 [05:58<00:00,  5.52s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:03<00:00,  1.35it/
                   all        258       3096      0.999      0.999      0.994      0.921

      Epoch    GPU_mem   box_loss   obj_loss   cls_loss  Instances       Size
      49/49       5.3G    0.02455    0.03029          0        394        416: 100% 65/65 [05:54<00:00,  5.45s/it]
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:05<00:00,  1.02s/i
                   all        258       3096      0.999      0.999      0.994      0.923

50 epochs completed in 5.084 hours.
Optimizer stripped from runs/train/exp/weights/last.pt, 42.1MB
Optimizer stripped from runs/train/exp/weights/best.pt, 42.1MB

Validating runs/train/exp/weights/best.pt...
Fusing layers...
Model summary: 212 layers, 20852934 parameters, 0 gradients, 47.9 GFLOPs
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 5/5 [00:24<00:00,  4.98s/i
                   all        258       3096      0.999      0.999      0.994      0.927
Results saved to runs/train/exp
Trainine time: 5:07:28.782347
```

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/exp/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/exp/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/exp/weights/best.pt --source /conten
```

```
detect: weights=['/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp/weights/best.pt'], source=/content/drive
requirements: /content/drive/MyDrive/42028_Assessment3/requirements.txt not found, check failed.
YOLOv5 🚀 v7.0-160-g867f7f0 Python-3.10.11 torch-2.0.0+cu118 CUDA:0 (Tesla T4, 15102MiB)

Fusing layers...
Model summary: 212 layers, 20852934 parameters, 0 gradients, 47.9 GFLOPs
image 1/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2001.jpg: 384x640 12 Empty_Seats, 46
image 2/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2021.jpg: 384x640 12 Empty_Seats, 19
image 3/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2034.jpg: 384x640 12 Empty_Seats, 19
image 4/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2064.jpg: 384x640 12 Empty_Seats, 19
image 5/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2095.jpg: 384x640 12 Empty_Seats, 20
image 6/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2098.jpg: 384x640 12 Empty_Seats, 20
image 7/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2103.jpg: 384x640 13 Empty_Seats, 19
image 8/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2122.jpg: 384x640 13 Empty_Seats, 19
image 9/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2130.jpg: 384x640 13 Empty_Seats, 19
image 10/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2146.jpg: 384x640 12 Empty_Seats, 1
image 11/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2160.jpg: 384x640 12 Empty_Seats, 1
image 12/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2161.jpg: 384x640 12 Empty_Seats, 1
image 13/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2186.jpg: 384x640 12 Empty_Seats, 1
image 14/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2189.jpg: 384x640 12 Empty_Seats, 1
image 15/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2197.jpg: 384x640 12 Empty_Seats, 1
image 16/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2200.jpg: 384x640 12 Empty_Seats, 1
image 17/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2201.jpg: 384x640 12 Empty_Seats, 1
image 18/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2202.jpg: 384x640 12 Empty_Seats, 1
image 19/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2206.jpg: 384x640 12 Empty_Seats, 1
image 20/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2241.jpg: 384x640 12 Empty_Seats, 1
image 21/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2253.jpg: 384x640 12 Empty_Seats, 1
image 22/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2262.jpg: 384x640 12 Empty_Seats, 1
image 23/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2293.jpg: 384x640 12 Empty_Seats, 1
image 24/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2317.jpg: 384x640 12 Empty_Seats, 1
image 25/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2330.jpg: 384x640 12 Empty_Seats, 1
image 26/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2337.jpg: 384x640 12 Empty_Seats, 1
image 27/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2378.jpg: 384x640 12 Empty_Seats, 1
image 28/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2379.jpg: 384x640 12 Empty_Seats, 1
image 29/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2391.jpg: 384x640 12 Empty_Seats, 1
image 30/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2392.jpg: 384x640 12 Empty_Seats, 1
image 31/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2397.jpg: 384x640 12 Empty_Seats, 1
image 32/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2400.jpg: 384x640 12 Empty_Seats, 1
image 33/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2403.jpg: 384x640 12 Empty_Seats, 1
image 34/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2418.jpg: 384x640 12 Empty_Seats, 1
image 35/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2452.jpg: 384x640 12 Empty_Seats, 1
image 36/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2455.jpg: 384x640 12 Empty_Seats, 1
image 37/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2459.jpg: 384x640 12 Empty_Seats, 1
image 38/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2466.jpg: 384x640 12 Empty_Seats, 1
image 39/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2474.jpg: 384x640 12 Empty_Seats, 1
image 40/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2488.jpg: 384x640 12 Empty_Seats, 1
image 41/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2492.jpg: 384x640 12 Empty_Seats, 1
image 42/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2502.jpg: 384x640 12 Empty_Seats, 1
image 43/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_2540.jpg: 384x640 12 Empty_Seats, 1
image 44/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3012.jpg: 384x640 12 Empty_Seats, 1
image 45/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3013.jpg: 384x640 13 Empty_Seats, 1
image 46/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3036.jpg: 384x640 13 Empty_Seats, 1
image 47/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3050.jpg: 384x640 12 Empty_Seats, 1
image 48/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3058.jpg: 384x640 12 Empty_Seats, 1
image 49/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3073.jpg: 384x640 12 Empty_Seats, 1
image 50/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3077.jpg: 384x640 12 Empty_Seats, 1
image 51/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3090.jpg: 384x640 12 Empty_Seats, 1
image 52/259 /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/images/empty_3091.jpg: 384x640 12 Empty_Seats, 1
```

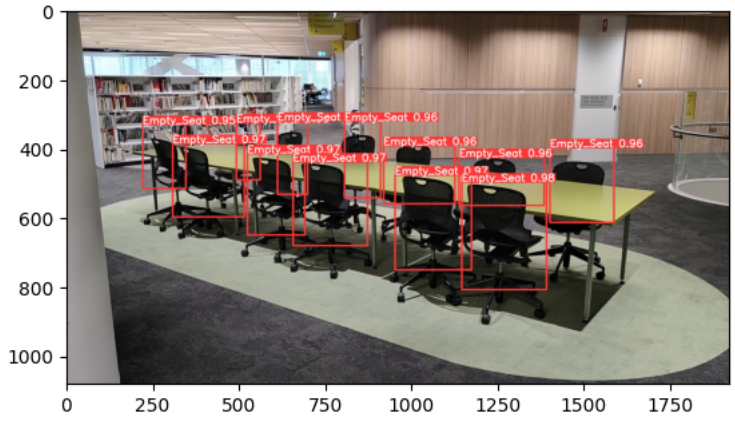
Show the result of test

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

```
<matplotlib.image.AxesImage at 0x7f91067de920>
```

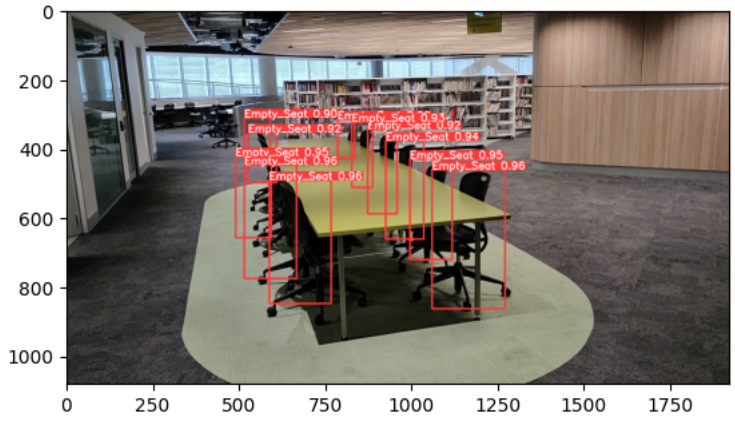
```
1 test_img2 = plt.imread("/content/drive/MyDrive/42028_Assessment3/yolov5/runs/detect/exp/empty_5052.jpg")
2 resize_img = cv2.resize(test_img2, (20, 20))
3 plt.imshow(test_img2)
```

```
<matplotlib.image.AxesImage at 0x7f90fb737070>
```



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

```
<matplotlib.image.AxesImage at 0x7f9106641960>
```



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/exp/results.png') # Change 'exp' to the last
3 #resize_img = cv2.resize(image, (20, 20))
4 plt.imshow(image)
```

```
<matplotlib.image.AxesImage at 0x7f910712b3d0>
```

Show Validation Reselt

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

val: data=data.yaml, weights=['/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp/weights/best.pt'], batch_si
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 T4, 15102MiB)

Fusing layers...
Model 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, 142MB/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,  3.68s/i
                   all        258       3096      0.999      0.997      0.994      0.842
Speed: 0.3ms pre-process, 11.5ms inference, 7.5ms NMS per image at shape (32, 3, 640, 640)
Results saved to runs/val/exp2
```

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)

```
#@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/test" #@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('data_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"

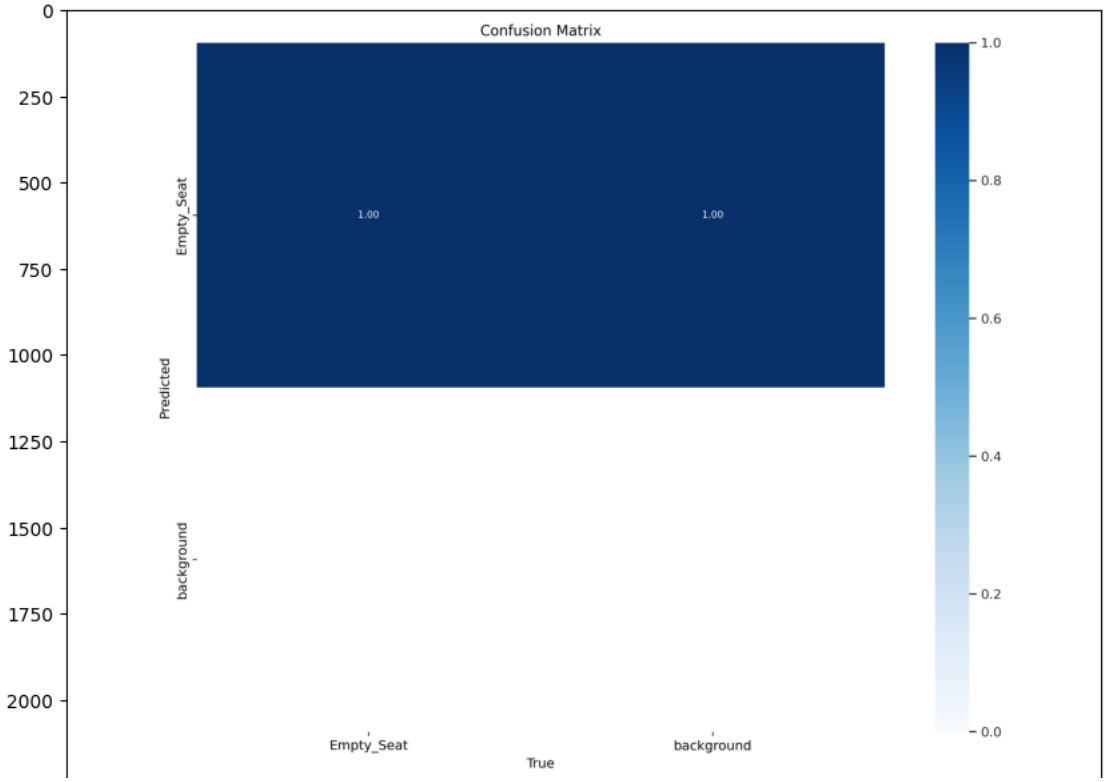
test_data_dir: "/content/drive/MyDrive/42028_Assessme"

class_names: ["Empty_Seat"]

```
# 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
!python val.py --weights /content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp/weights/best.pt --data data_yaml

val: data=data_yaml, weights=['/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp/weights/best.pt'], batch_si
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 T4, 15102MiB)

Fusing layers...
Model summary: 212 layers, 20852934 parameters, 0 gradients, 47.9 GFLOPs
val: Scanning /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/labels... 258 images, 1 backgrounds, 0 corrupt:
val: New cache created: /content/drive/MyDrive/42028_Assessment3/dataset_empty/test/labels.cache
                 Class     Images  Instances          P          R      mAP50   mAP50-95: 100% 9/9 [00:22<00:00,  2.51s/i
                   all        259       3096      0.995      0.998      0.994      0.843
Speed: 0.2ms pre-process, 10.4ms inference, 4.9ms NMS per image at shape (32, 3, 640, 640)
Results saved to runs/val/exp3
```

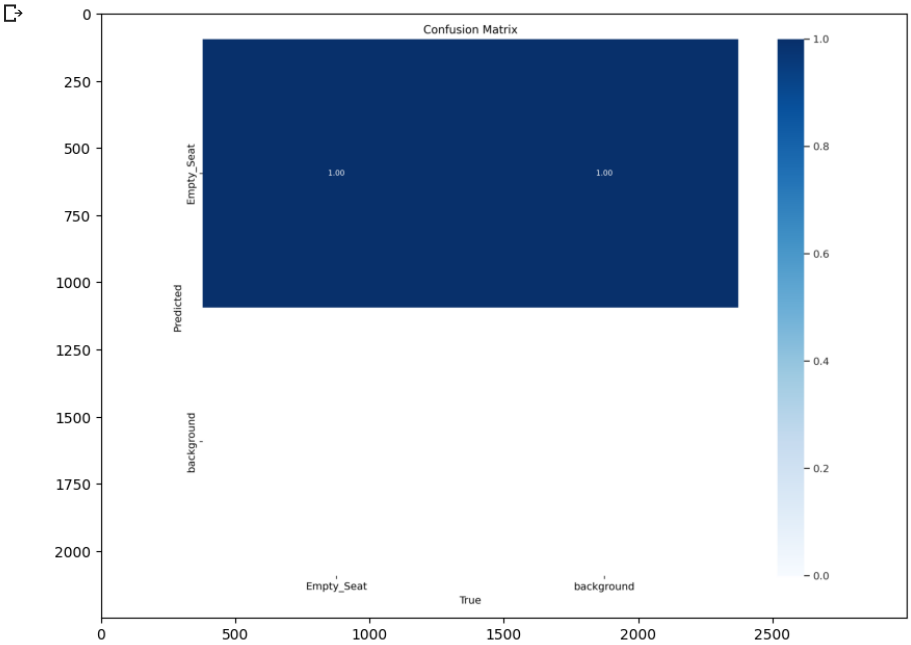
Confunsion Matrix - Train

```
import matplotlib.pyplot as plt
import matplotlib.image as image

img = image.imread('/content/drive/MyDrive/42028_Assessment3/yolov5/runs/train/exp/confusion_matrix.png')
fig = plt.figure(figsize=(10, 10), dpi=100)
plt.imshow(img)
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/exp2/confusion_matrix.png')
5 fig = plt.figure(figsize=(10, 10), dpi=100)
6 plt.imshow(img)
7 plt.show()
```



Confusion Matrix - Test

```
import matplotlib.pyplot as plt
import matplotlib.image as image

img = image.imread('/content/drive/MyDrive/42028_Assessment3/yolov5/runs/val/exp3/confusion_matrix.png')
fig = plt.figure(figsize=(10, 10), dpi=100)
plt.imshow(img)
plt.show()
```