

Importing the Libraries

```
In [1]: import warnings
warnings.filterwarnings('ignore')

In [2]: import torch
from IPython.display import Image
import shutil
import os
from random import choice

In [3]: device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
device

Out[3]: device(type='cuda', index=0)

In [4]: ML_Model = []
precision = []
recall = []
mAP = []

#function to call for storing the results
def storeResults(model, a,b,c):
    ML_Model.append(model)
    precision.append(round(a, 3))
    recall.append(round(b, 3))
    mAP.append(round(c, 3))
```

Yolo v5s6

```
In [5]: !mkdir v5

In [6]: cd v5
/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/v5

In [7]: from ultralytics import YOLO
# Load a model

# model = YOLO("yolov8m.yaml") # build a new model from scratch
model = YOLO("yolov5s6u.pt") # Load a pretrained model (recommended for training)

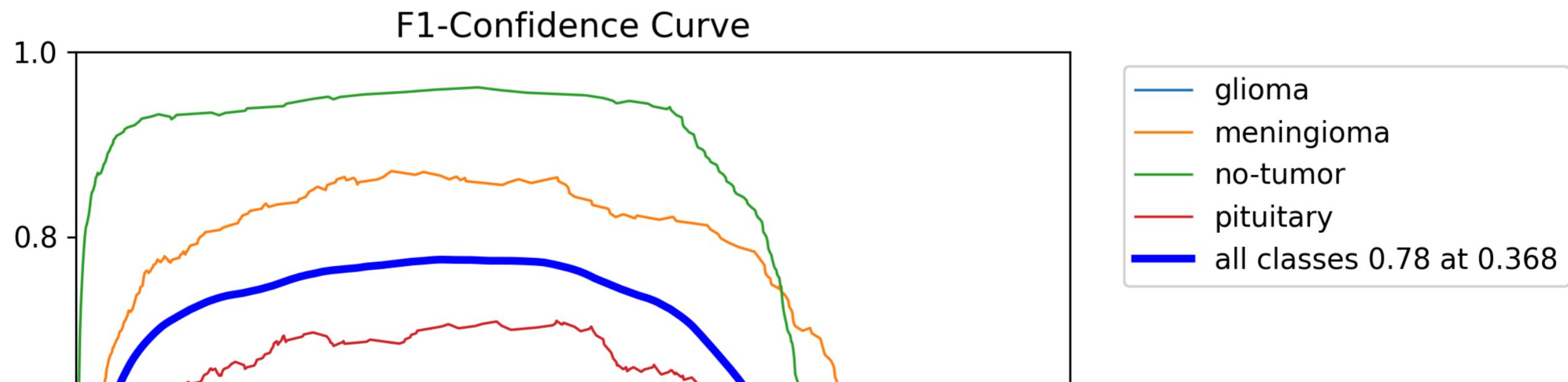
# Use the model
results = model.train(data="/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov5/data.yaml", epochs=50, imgsz=416) # train the
↓
Downloading https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov5s6u.pt (https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov5s6u.pt) to 'yolov5s6u.pt'...
100%|██████████| 29.6M/29.6M [00:02<00:00, 11.7MB/s]

New https://pypi.org/project/ultralytics/8.3.56 (https://pypi.org/project/ultralytics/8.3.56) available 🎉 Update with 'pip install -U ultralytics'
Ultralytics 8.3.6 🚀 Python-3.10.9 torch-2.5.0+cu124 CUDA:0 (NVIDIA GeForce RTX 4090, 24564MiB)
engine/trainer: task=detect, mode=train, model=yolov5s6u.pt, data=/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov5/data.yaml, epochs=50, time=None, patience=1
00, batch=16, imgsz=416, save=True, save_period=1, cache=False, device=None, workers=8, project=None, name=train, exist_ok=False, pretrained=True, optimizer=auto, verbose=True,
seed=0, deterministic=True, single_cls=False, rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profile=False, freeze=None, multi_scale=False,
overlap_mask=True, mask_ratio=4, dropout=0.0, val=True, split=val, save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300, half=False, dnn=False, plots=True,
source=None, vid_stride=1, stream_buffer=False, visualize=False, augment=False, agnostic_nms=False, classes=None, retina_masks=False, embed=None, show=False, save_frames=False,
save_txt=False, save_conf=False, save_crop=False, show_labels=True, show_conf=True, show_boxes=True, line_width=None, format=torchscript, keras=False, optimize=False, int8=False,
dynamic=False, simplify=True, opset=None, workspace=4, nms=False, lr0=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=7.5, cls=0.5, df1=1.5, pose=12.0, kobj=1.0, label_smoothing=0.0, nbs=64, 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, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, copy_paste_mode=flip, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None,
tracker=botsort.yaml, save_dir=runs/detect/train
Overriding model.yaml nc=80 with nc=4

      from    n      params     module           arguments
In [5]: p_yol5 = 0.821
r_yol5 = 0.734
mAP_yolo5 = 0.793

storeResults('Yolo v5s6',p_yol5,r_yol5,mAP_yolo5)

In [8]: # displaying metrics for train data
from IPython.display import Image
from IPython.display import display
x = Image(filename='runs/detect/train/F1_curve.png')
y = Image(filename='runs/detect/train/PR_curve.png')
z = Image(filename='runs/detect/train/confusion_matrix.png')
display(x, y, z)
```



Yolo v5x6

```
In [9]: model = YOLO("yolov5x6u.pt") # Load a pretrained model (recommended for training)

# Use the model
results = model.train(data="/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov5/data.yaml", epochs=50, imgsz=416) # train the

Downloading https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov5x6u.pt (https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov5x6u.pt) to 'yolov5x6u.pt'...
100%|██████████| 297M/297M [02:41<00:00, 1.93MB/s]

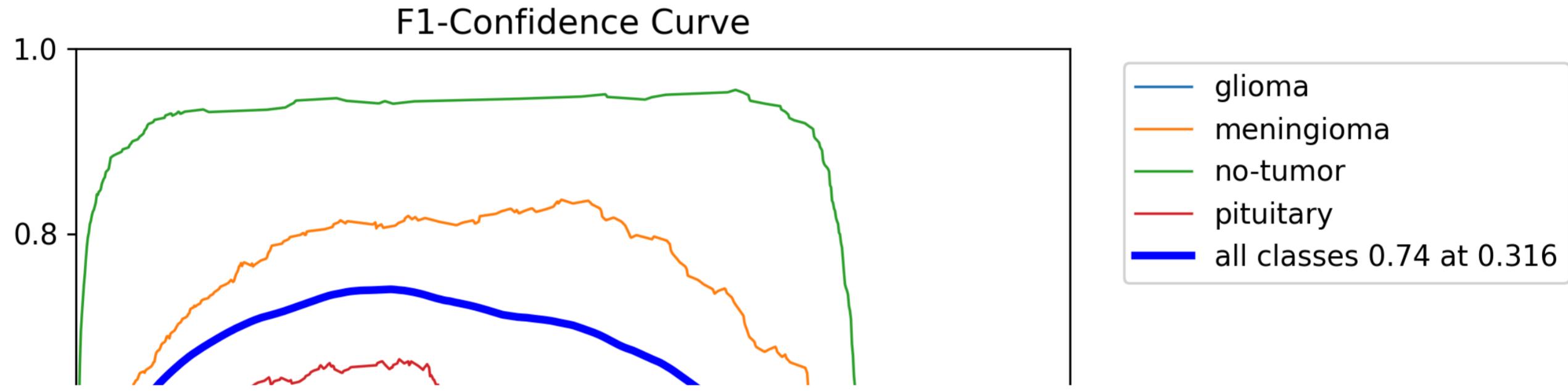
New https://pypi.org/project/ultralytics/8.3.56 (https://pypi.org/project/ultralytics/8.3.56) available 😊 Update with 'pip install -U ultralytics'
Ultralytics 8.3.6 🚀 Python-3.10.9 torch-2.5.0+cu124 CUDA:0 (NVIDIA GeForce RTX 4090, 24564MiB)
engine/trainer: task=detect, mode=train, model=yolov5x6u.pt, data=/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov5/data.yaml, epochs=50, time=None, patience=100, batch=16, imgsz=416, save=True, save_period=-1, cache=False, device=None, workers=8, project=None, name=train2, exist_ok=False, pretrained=True, optimizer=auto, verbose=True, seed=0, deterministic=True, single_cls=False, rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profile=False, freeze=None, multi_scale=False, overlap_mask=True, mask_ratio=4, dropout=0.0, val=True, split=val, save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300, half=False, dnn=False, plots=True, source=None, vid_stride=1, stream_buffer=False, visualize=False, augment=False, agnostic_nms=False, classes=None, retina_masks=False, embed=None, show=False, save_frames=False, save_txt=False, save_conf=False, save_crop=False, show_labels=True, show_conf=True, show_boxes=True, line_width=None, format=torchscript, keras=False, optimize=False, int8=False, dynamic=False, simplify=True, opset=None, workspace=4, nms=False, lr0=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=7.5, cls=0.5, df1=1.5, pose=12.0, kobj=1.0, label_smoothing=0.0, nbs=64, 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, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, copy_paste_mode=flip, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.yaml, save_dir=runs/detect/train2
Overriding model.yaml nc=80 with nc=4
```

from	n	params	module	arguments

```
In [6]: p_yol5 = 0.737
r_yol5 = 0.745
mAP_yolo5 = 0.76

storeResults('Yolo v5x6',p_yol5,r_yol5,mAP_yolo5)
```

```
In [10]: # displaying metrics for train data
from IPython.display import Image
from IPython.display import display
x = Image(filename='runs/detect/train2/F1_curve.png')
y = Image(filename='runs/detect/train2/PR_curve.png')
z = Image(filename='runs/detect/train2/confusion_matrix.png')
display(x, y, z)
```



Yolo v8

```
In [11]: cd /mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24

/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24

In [12]: !mkdir v8

In [13]: cd v8
/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/v8

In [14]: model = YOLO("yolov8n.pt") # Load a pretrained model (recommended for training)

# Use the model
results = model.train(data="/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov8/data.yaml", epochs=50, imgsz=416) # train the

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100%|██████████| 6.25M/6.25M [00:00<00:00, 61.9MB/s]

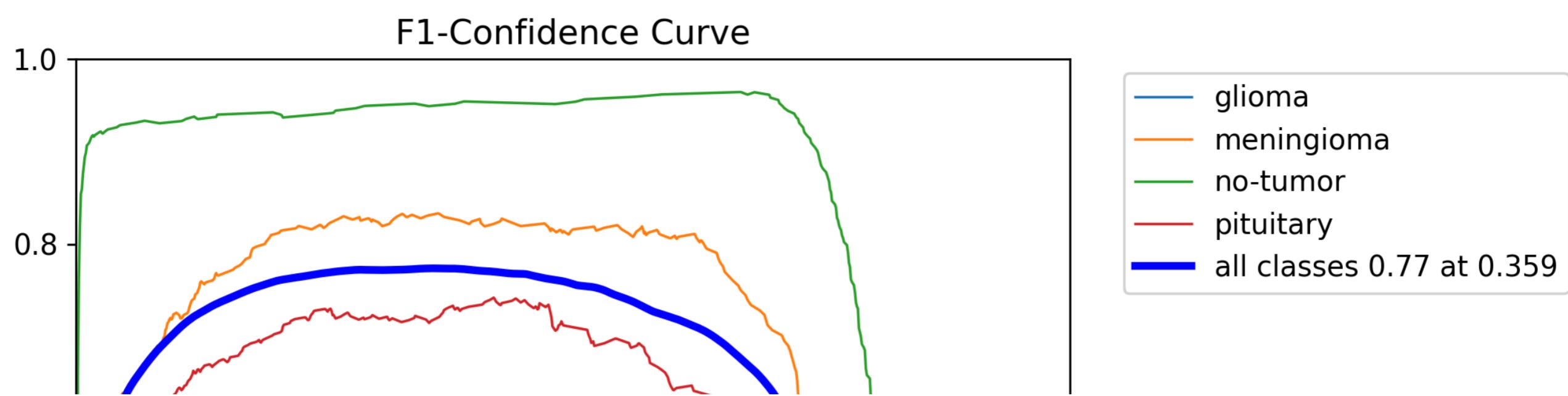
New https://pypi.org/project/ultralytics/8.3.56 (https://pypi.org/project/ultralytics/8.3.56) available 😊 Update with 'pip install -U ultralytics'
Ultralytics 8.3.6 🚀 Python-3.10.9 torch-2.5.0+cu124 CUDA:0 (NVIDIA GeForce RTX 4090, 24564MiB)

engine/trainer: task=detect, mode=train, model=yolov8n.pt, data=/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov8/data.yaml, epochs=50, time=None, patience=100, batch=16, imgsz=416, save=True, save_period=-1, cache=False, device=None, workers=8, project=None, name=v8, exist_ok=False, pretrained=True, optimizer=auto, verbose=True, seed=0, deterministic=True, single_cls=False, rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profile=False, freeze=None, multi_scale=False, overlap_mask=True, mask_ratio=4, dropout=0.0, val=True, split=val, save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300, half=False, dnn=False, plots=True, source=None, vid_stride=1, stream_buffer=False, visualize=False, augment=False, agnostic_nms=False, classes=None, retina_masks=False, embed=None, show=False, save_frames=False, save_txt=False, save_conf=False, save_crop=False, show_labels=True, show_conf=True, show_boxes=True, line_width=None, format=torchscript, keras=False, optimize=False, int8=False, dynamic=False, simplify=True, opset=None, workspace=4, nms=False, lr0=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=7.5, cls=0.5, df1=1.5, pose=12.0, kobj=1.0, label_smoothing=0.0, nbs=64, 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, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, copy_paste_mode=flip, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.yaml, save_dir=runs/detect/train
Overriding model.yaml nc=80 with nc=4
```

```
In [7]: p_yol5 = 0.793
r_yol5 = 0.761
mAP_yolo5 = 0.813

storeResults('Yolo v8',p_yol5,r_yol5,mAP_yolo5)
```

```
In [15]: x = Image(filename='runs/detect/train/F1_curve.png')
y = Image(filename='runs/detect/train/PR_curve.png')
z = Image(filename='runs/detect/train/confusion_matrix.png')
display(x, y, z)
```



Yolo v9

```
In [16]: cd /mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24
/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24
```

```
In [17]: !mkdir v9
```

```
In [18]: cd v9
/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/v9
```

```
In [19]: model = YOLO("yolov9c.pt")

# Use the model
results = model.train(data="/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov9/data.yaml", epochs=50, imgsz=416) # train the model
```

Downloading <https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov9c.pt> (<https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov9c.pt>) to 'yolov9c.pt'...

100% |██████████| 49.4M/49.4M [00:02<00:00, 25.1MB/s]

New <https://pypi.org/project/ultralytics/8.3.56> (<https://pypi.org/project/ultralytics/8.3.56>) available 😊 Update with 'pip install -U ultralytics'

Ultralytics 8.3.6 🎉 Python-3.10.9 torch-2.5.0+cu124 CUDA:0 (NVIDIA GeForce RTX 4090, 24564MiB)

engine/trainer: task=detect, mode=train, model=yolov9c.pt, data=/mnt/c/Users/TruProjects/Desktop/Truprojects/24-25/Yolo/24/yolov9/data.yaml, epochs=50, time=None, patience=100, batch=16, imgsz=416, save=True, save_period=-1, cache=False, device=None, workers=8, project=None, name=train, exist_ok=False, pretrained=True, optimizer=auto, verbose=True, seed=0, deterministic=True, single_cls=False, rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profile=False, freeze=None, multi_scale=False, overlap_mask=True, mask_ratio=4, dropout=0.0, val=True, split=val, save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300, half=False, dnn=False, plots=True, source=None, vid_stride=1, stream_buffer=False, visualize=False, augment=False, agnostic_nms=False, retina_masks=False, embed=None, show=False, save_frames=False, save_txt=False, save_conf=False, save_crop=False, show_labels=True, show_conf=True, show_boxes=True, line_width=None, format=torchscript, keras=False, optimize=False, int8=False, dynamic=False, simplify=True, opset=None, workspace=4, nms=False, lr0=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=7.5, cls=0.5, df1=1.5, pose=12.0, kobj=1.0, label_smoothing=0.0, nbs=64, 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, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, copy_paste_mode=flip, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.yaml, save_dir=runs/detect/train

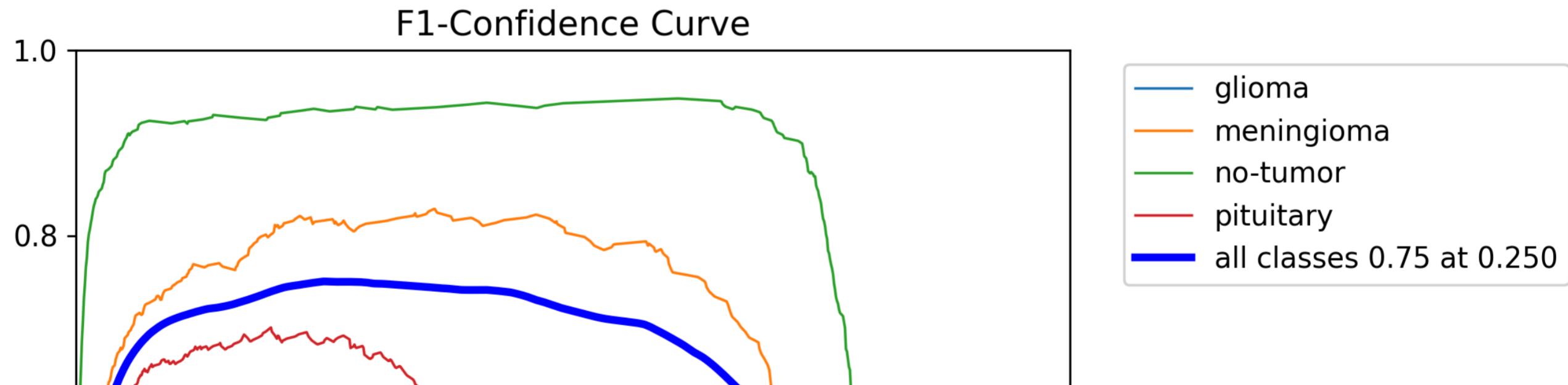
Overriding model.yaml nc=80 with nc=4

from	n	params	module	arguments
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```
In [8]: p_yol5 = 0.762
r_yol5 = 0.748
mAP_yolo5 = 0.791
```

```
storeResults('Yolo v9', p_yol5, r_yol5, mAP_yolo5)
```

```
In [20]: x = Image(filename='runs/detect/train/F1_curve.png')
y = Image(filename='runs/detect/train/PR_curve.png')
z = Image(filename='runs/detect/train/confusion_matrix.png')
display(x, y, z)
```



Comparison

```
In [9]: #creating dataframe
import pandas as pd
result = pd.DataFrame({ 'ML Model' : ML_Model,
                        'Precision' : precision,
                        'Recall' : recall,
                        'mAP' : mAP,
                    })
```

```
In [10]: result
```

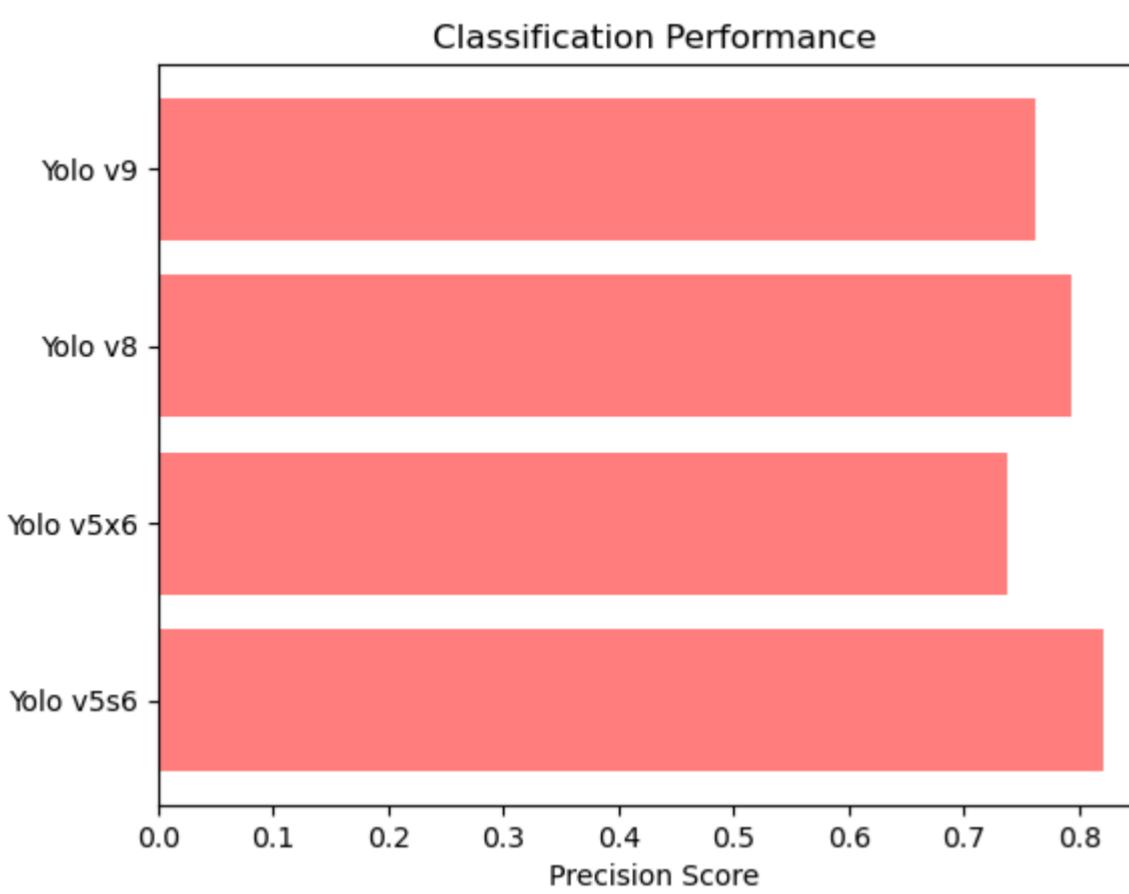
```
Out[10]:
ML Model Precision Recall mAP
0 Yolo v5s6 0.821 0.734 0.793
1 Yolo v5x6 0.737 0.745 0.760
2 Yolo v8 0.793 0.761 0.813
3 Yolo v9 0.762 0.748 0.791
```

Graph

```
In [11]: import numpy as np
classifier = ML_Model
y_pos = np.arange(len(classifier))
```

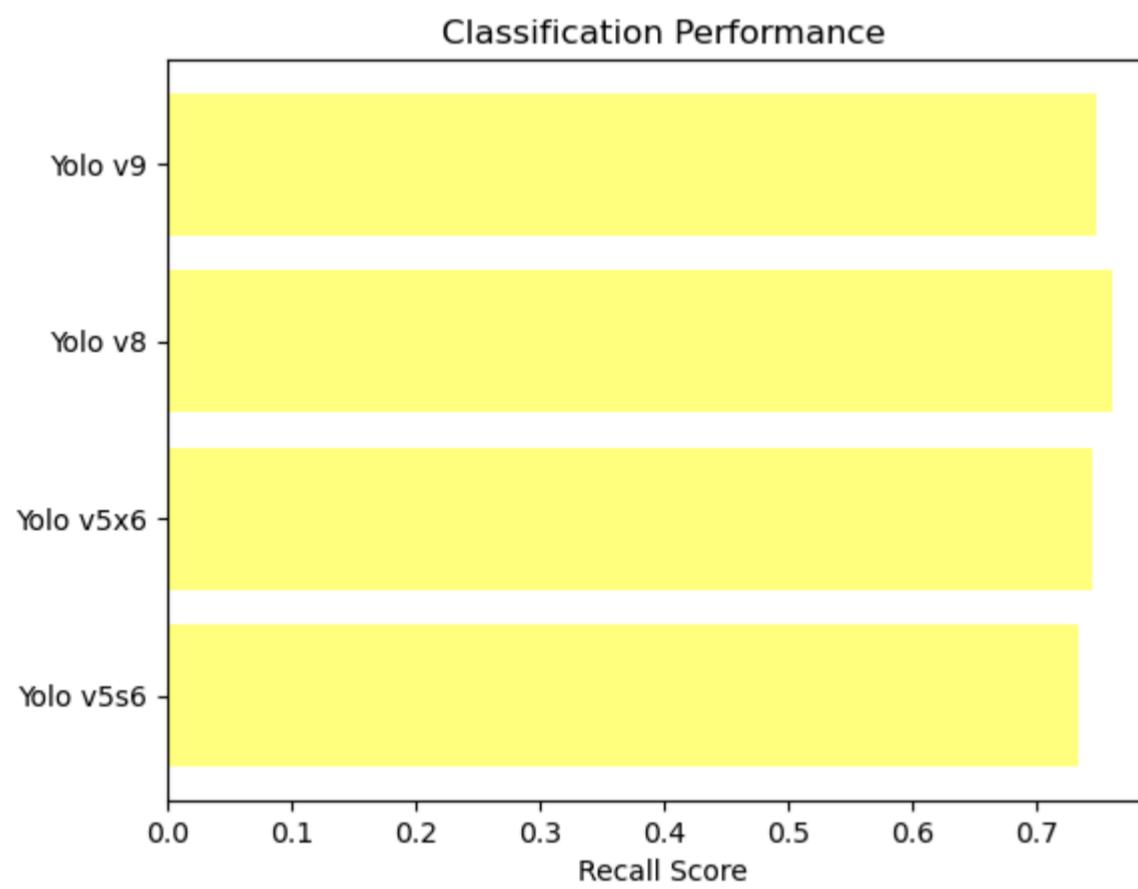
Precision

```
In [12]: import matplotlib.pyplot as plt2
plt2.barr(y_pos, precision, align='center', alpha=0.5,color='red')
plt2.yticks(y_pos, classifier)
plt2.xlabel('Precision Score')
plt2.title('Classification Performance')
plt2.show()
```



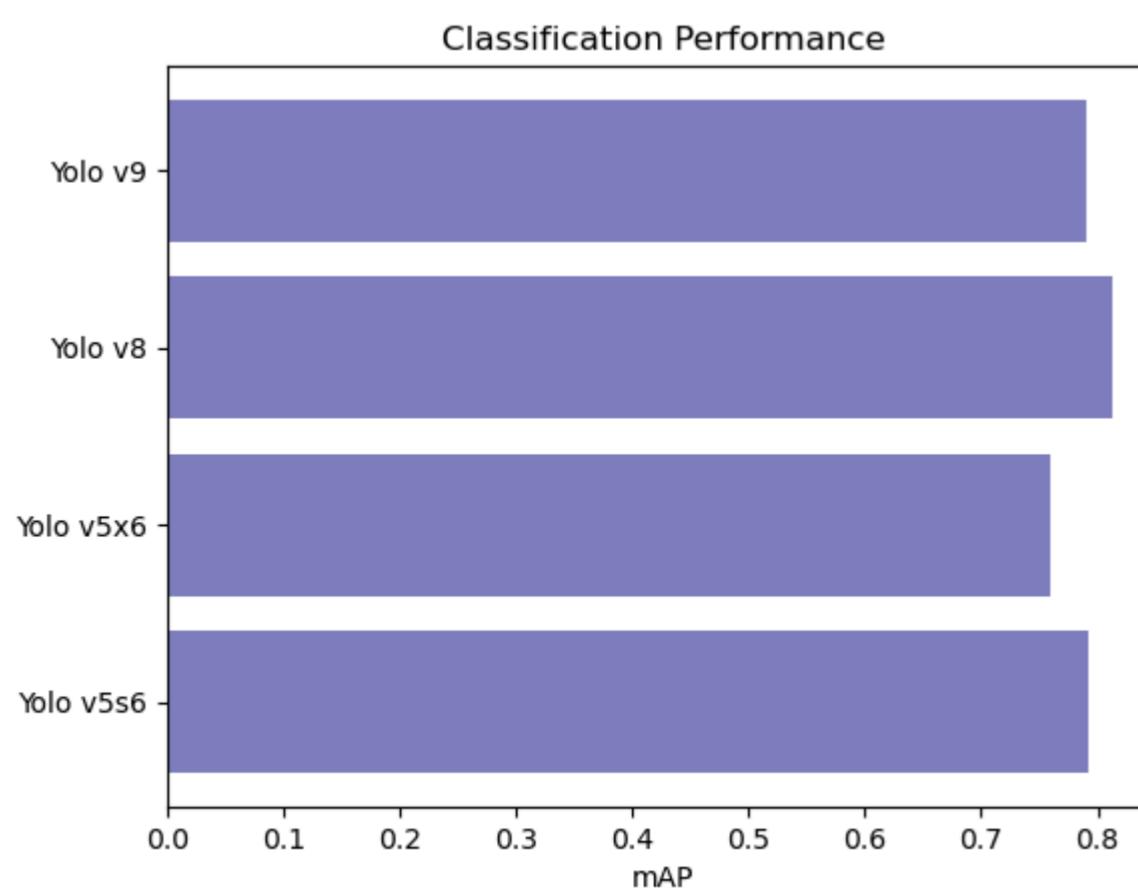
Recall

```
In [13]: plt2.barr(y_pos, recall, align='center', alpha=0.5,color='yellow')
plt2.yticks(y_pos, classifier)
plt2.xlabel('Recall Score')
plt2.title('Classification Performance')
plt2.show()
```



mAP

```
In [14]: plt2.barr(y_pos, mAP, align='center', alpha=0.5,color='navy')
plt2.yticks(y_pos, classifier)
plt2.xlabel('mAP')
plt2.title('Classification Performance')
plt2.show()
```



In []:

In []: