abnormal-activity-detection-using-yolov12

March 22, 2025

0.1 Environment setup

0.1.1 Configure your API keys

To fine-tune YOLOv12, you need to provide your Roboflow API key. Follow these steps:

- Go to your Roboflow Settings page. Click Copy. This will place your private key in the clipboard.
- In Colab, go to the left pane and click on Secrets ( ). Store Roboflow API Key under the name ROBOFLOW_API_KEY.

[39]:
```
import os

from kaggle_secrets import UserSecretsClient
user_secrets = UserSecretsClient()
os.environ["ROBOFLOW_API_KEY"] = user_secrets.get_secret("ROBOFLOW_API_KEY")
```

0.1.2 Check GPU availability

NOTE: YOLOv12 leverages FlashAttention to speed up attention-based computations, but this feature requires an Nvidia GPU built on the Ampere architecture or newer—for example, GPUs like the RTX 3090, RTX 3080, or even the Nvidia L4 meet this requirement.

Let's make sure that we have access to GPU. We can use nvidia-smi command to do that. In case of any problems navigate to Edit -> Notebook settings -> Hardware accelerator, set it to GPU, and then click Save.

[40]:
```
!nvidia-smi
```

```
Sat Mar 22 02:54:27 2025
+-----------------------------------------------------------------------------
----------+
| NVIDIA-SMI 560.35.03              Driver Version: 560.35.03      CUDA Version:
12.6     |
|-----------------------------------------+------------------------+-----------
----------+
| GPU  Name                 Persistence-M | Bus-Id          Disp.A | Volatile
Uncorr. ECC |
| Fan  Temp   Perf          Pwr:Usage/Cap |           Memory-Usage | GPU-Util
Compute M. |
```

```
|                                         |                      |
MIG M. |
|=========================================+======================+============
==========|
|   0  Tesla T4                       Off |   00000000:00:04.0 Off |
0 |
| N/A   36C    P8              9W /   70W |       3MiB /  15360MiB |      0%
Default |
|                                         |                      |
N/A |
+-----------------------------------------+----------------------+------------
----------+
|   1  Tesla T4                       Off |   00000000:00:05.0 Off |
0 |
| N/A   38C    P8              9W /   70W |       3MiB /  15360MiB |      0%
Default |
|                                         |                      |
N/A |
+-----------------------------------------+----------------------+------------
----------+

+---------------------------------------------------------------------------------
----------+
| Processes:
|
|  GPU   GI   CI        PID   Type   Process name
GPU Memory |
|        ID   ID
Usage      |
|=================================================================================
==========|
|  No running processes found
|
+---------------------------------------------------------------------------------
----------+
```

[41]:
```
import os
HOME = os.getcwd()
print(HOME)
```

```
/kaggle/working
```

0.1.3 Install dependencies

NOTE: Currently, YOLOv12 does not have its own PyPI package, so we install it directly from GitHub while also adding roboflow (to conveniently pull datasets from the Roboflow Universe), supervision (to visualize inference results and benchmark the model's performance), and flash-attn (to accelerate attention-based computations via optimized CUDA kernels).

[42]:
```
!pip install -q git+https://github.com/sunsmarterjie/yolov12.git tensorflow==2.
↪17.0 roboflow supervision flash-attn
```

```
  Installing build dependencies … done
  Getting requirements to build wheel … done
  Preparing metadata (pyproject.toml) … done
```

0.2 Download dataset from Roboflow Universe

[43]:
```
from roboflow import download_dataset

dataset = download_dataset('https://universe.roboflow.com/
↪le-quy-don-high-school-for-gifted-students-gfeop/abnormal-activities-u130g/
↪dataset/1', 'yolov8')
# dataset = download_dataset('https://universe.roboflow.com/roboflow-100/
↪circuit-voltages/dataset/2', 'yolov8')
```

```
loading Roboflow workspace…
loading Roboflow project…

Downloading Dataset Version Zip in Abnormal-Activities-1 to yolov8::
100%|      | 386944/386944 [00:05<00:00, 73432.63it/s]



Extracting Dataset Version Zip to Abnormal-Activities-1 in yolov8::
100%|      | 19090/19090 [00:02<00:00, 8088.48it/s]
```

[44]:
```
!ls {dataset.location}
```

```
data.yaml  README.dataset.txt  README.roboflow.txt  test  train  valid
```

NOTE: We need to make a few changes to our downloaded dataset so it will work with YOLOv12. Run the following bash commands to prepare your dataset for training by updating the relative paths in the `data.yaml` file, ensuring it correctly points to the subdirectories for your dataset's `train`, `test`, and `valid` subsets.

[45]:
```
!sed -i '$d' {dataset.location}/data.yaml
!sed -i '$d' {dataset.location}/data.yaml
!sed -i '$d' {dataset.location}/data.yaml
!sed -i '$d' {dataset.location}/data.yaml
!echo -e "test: ../test/images\ntrain: ../train/images\nval: ../valid/images"␣
↪>> {dataset.location}/data.yaml
```

[46]:
```
!cat {dataset.location}/data.yaml
```

```
names:
- Aggressor
- Discussion_WGI
- Discussions_WOBoard
```

```
- Discussions_ppl
- Hand
- Item_passed
- Knife_Deploy
- Knife_Weapon
- NonViolence
- Person
- Stabbing
- Victim
- Violence
- Writing_Board
- gun
- hang
nc: 16
roboflow:
  license: CC BY 4.0
  project: abnormal-activities-u130g
  url: https://universe.roboflow.com/le-quy-don-high-school-for-gifted-students-
gfeop/abnormal-activities-u130g/dataset/1
  version: 1
test: ../test/images
train: ../train/images
val: ../valid/images
```

0.3 Fine-tune YOLOv12 model

We are now ready to fine-tune our YOLOv12 model. In the code below, we initialize the model using a starting checkpoint—here, we use `yolov12s.yaml`, but you can replace it with any other model (e.g., `yolov12n.pt`, `yolov12m.pt`, `yolov12l.pt`, or `yolov12x.pt`) based on your preference. We set the training to run for 100 epochs in this example; however, you should adjust the number of epochs along with other hyperparameters such as batch size, image size, and augmentation settings (scale, mosaic, mixup, and copy-paste) based on your hardware capabilities and dataset size.

Note: Note that after training, you might encounter a `TypeError: argument of type 'PosixPath' is not iterable` error — this is a known issue, but your model weights will still be saved, so you can safely proceed to running inference.

[47]:
```
from ultralytics import YOLO

model = YOLO('yolov12s.yaml')

results = model.train(data=f'{dataset.location}/data.yaml', epochs=100)
```

```
New https://pypi.org/project/ultralytics/8.3.94 available  Update with 'pip
install -U ultralytics'
Ultralytics 8.3.63  Python-3.10.12 torch-2.5.1+cu121 CUDA:0 (Tesla T4,
15095MiB)
engine/trainer: task=detect, mode=train, model=yolov12s.yaml,
data=/kaggle/working/Abnormal-Activities-1/data.yaml, epochs=100, time=None,
```

```
patience=100, batch=16, imgsz=640, 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=None, 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=0.0,
box=7.5, cls=0.5, dfl=1.5, pose=12.0, kobj=1.0, 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=0.1,
copy_paste_mode=flip, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0,
cfg=None, tracker=botsort.yaml, save_dir=runs/detect/train
Downloading https://ultralytics.com/assets/Arial.ttf to
'/root/.config/yolov12/Arial.ttf'…

100%|     | 755k/755k [00:00<00:00, 16.3MB/s]

Overriding model.yaml nc=80 with nc=16

                   from  n    params  module
arguments
  0                  -1  1       928  ultralytics.nn.modules.conv.Conv
[3, 32, 3, 2]
  1                  -1  1      9344  ultralytics.nn.modules.conv.Conv
[32, 64, 3, 2, 1, 2]
  2                  -1  1     26080  ultralytics.nn.modules.block.C3k2
[64, 128, 1, False, 0.25]
  3                  -1  1     37120  ultralytics.nn.modules.conv.Conv
[128, 128, 3, 2, 1, 4]
  4                  -1  1    103360  ultralytics.nn.modules.block.C3k2
[128, 256, 1, False, 0.25]
  5                  -1  1    590336  ultralytics.nn.modules.conv.Conv
[256, 256, 3, 2]
  6                  -1  2    677120  ultralytics.nn.modules.block.A2C2f
[256, 256, 2, True, 4]
  7                  -1  1   1180672  ultralytics.nn.modules.conv.Conv
[256, 512, 3, 2]
  8                  -1  2   2664960  ultralytics.nn.modules.block.A2C2f
[512, 512, 2, True, 1]
  9                  -1  1         0  torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']
```

```
 10             [-1, 6]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 11                 -1  1    345856  ultralytics.nn.modules.block.A2C2f
[768, 256, 1, False, -1]
 12                 -1  1         0  torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']
 13             [-1, 4]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 14                 -1  1     95104  ultralytics.nn.modules.block.A2C2f
[512, 128, 1, False, -1]
 15                 -1  1    147712  ultralytics.nn.modules.conv.Conv
[128, 128, 3, 2]
 16            [-1, 11]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 17                 -1  1    296704  ultralytics.nn.modules.block.A2C2f
[384, 256, 1, False, -1]
 18                 -1  1    590336  ultralytics.nn.modules.conv.Conv
[256, 256, 3, 2]
 19             [-1, 8]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 20                 -1  1   1511424  ultralytics.nn.modules.block.C3k2
[768, 512, 1, True]
 21        [14, 17, 20]  1    825600  ultralytics.nn.modules.head.Detect
[16, [128, 256, 512]]
YOLOv12s summary: 497 layers, 9,102,656 parameters, 9,102,640 gradients, 19.6
GFLOPs

TensorBoard: Start with 'tensorboard --logdir runs/detect/train',
view at http://localhost:6006/
Freezing layer 'model.21.dfl.conv.weight'
AMP: running Automatic Mixed Precision (AMP) checks…
Downloading
https://github.com/sunsmarterjie/yolov12/releases/download/turbo/yolov12n.pt to
'yolov12n.pt'…

100%|      | 5.26M/5.26M [00:00<00:00, 73.8MB/s]

AMP: checks passed

train: Scanning /kaggle/working/Abnormal-
Activities-1/train/labels… 6214 images, 422 backgrounds, 0 corrupt:
100%|      | 6214/6214 [00:05<00:00, 1137.84it/s]

train: New cache created: /kaggle/working/Abnormal-
Activities-1/train/labels.cache
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, num_output_channels=3,
method='weighted_average'), CLAHE(p=0.01, clip_limit=(1.0, 4.0),
tile_grid_size=(8, 8))
```

```
A new version of Albumentations is available: 2.0.5 (you have 1.4.20). Upgrade
using: pip install -U albumentations. To disable automatic update checks, set
the environment variable NO_ALBUMENTATIONS_UPDATE to 1.
val: Scanning /kaggle/working/Abnormal-Activities-1/valid/labels…
2061 images, 143 backgrounds, 0 corrupt: 100%|      | 2061/2061
[00:01<00:00, 1113.09it/s]

val: New cache created: /kaggle/working/Abnormal-
Activities-1/valid/labels.cache
Plotting labels to runs/detect/train/labels.jpg…
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and
'momentum=0.937' and determining best 'optimizer', 'lr0' and 'momentum'
automatically…
optimizer: AdamW(lr=0.0005, momentum=0.9) with parameter groups 121
weight(decay=0.0), 128 weight(decay=0.0005), 127 bias(decay=0.0)
TensorBoard: model graph visualization added
Image sizes 640 train, 640 val
Using 2 dataloader workers
Logging results to runs/detect/train
Starting training for 100 epochs…

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      1/100      6.75G      3.212      4.785      4.001         20        640:
100%|     | 389/389 [03:26<00:00,  1.88it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|     | 65/65 [00:28<00:00,  2.27it/s]

                   all       2061       3641      0.632     0.0113    0.00247
0.000569

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      2/100      6.86G       2.48      3.931      3.041         30        640:
100%|     | 389/389 [03:26<00:00,  1.88it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|     | 65/65 [00:26<00:00,  2.43it/s]

                   all       2061       3641      0.083     0.0452     0.0162
0.00415

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      3/100      6.86G      2.158      3.522      2.635         37        640:
100%|     | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|     | 65/65 [00:26<00:00,  2.44it/s]

                   all       2061       3641      0.442      0.076     0.0537
0.0228
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      4/100      6.86G       1.98      3.221      2.422         20        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.46it/s]
                   all       2061       3641      0.629     0.0574     0.0789
0.035

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      5/100      6.86G      1.837      2.948      2.269         27        640:
100%|      | 389/389 [03:23<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.45it/s]
                   all       2061       3641      0.561     0.0999      0.106
0.0499

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      6/100      6.86G      1.734      2.764       2.16         24        640:
100%|      | 389/389 [03:23<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.42it/s]
                   all       2061       3641      0.662     0.0673      0.132
0.0651

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      7/100      6.91G      1.655       2.63      2.091         20        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.47it/s]
                   all       2061       3641       0.66      0.195      0.244
0.134

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      8/100      6.86G      1.582      2.489      2.012         29        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.47it/s]
                   all       2061       3641      0.562      0.247      0.236
0.142

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      9/100      6.87G       1.52      2.364      1.955         29        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]

                   all       2061       3641      0.573      0.253      0.306
0.178

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     10/100      6.85G      1.476       2.26      1.906         17        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]

                   all       2061       3641      0.671      0.271      0.307
0.188

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     11/100      6.87G      1.434      2.167      1.867         12        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.43it/s]

                   all       2061       3641      0.518      0.358      0.365
0.233

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     12/100      6.86G      1.404      2.093      1.832         20        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.47it/s]

                   all       2061       3641      0.435      0.356      0.353
0.212

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     13/100      6.86G      1.365      2.012      1.794         27        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.47it/s]

                   all       2061       3641      0.319      0.404      0.339
0.214

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     14/100      6.82G      1.338      1.963      1.768         28        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
```

```
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.762      0.327      0.405
0.271

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     15/100      6.85G      1.313        1.9      1.743         25        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.572      0.403      0.423
0.267

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     16/100      6.85G      1.287       1.85      1.718         35        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.491       0.39      0.401
0.26

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     17/100      6.86G      1.269      1.806      1.693         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.609      0.397      0.418
0.267

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     18/100      6.82G      1.247      1.767      1.677         14        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.688      0.396      0.434
0.289

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     19/100      6.86G      1.239      1.738      1.671         17        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
```

```
                 all       2061       3641      0.609      0.407      0.433
0.283

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     20/100      6.84G      1.212      1.684      1.638         13        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]

                 all       2061       3641      0.652      0.397      0.432
0.303

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     21/100      6.85G      1.199      1.661      1.627         20        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                 all       2061       3641      0.561       0.41      0.458
0.309

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     22/100      6.84G      1.188      1.637      1.615         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]

                 all       2061       3641      0.646      0.419      0.493
0.329

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     23/100      6.86G      1.179      1.628      1.608         26        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]

                 all       2061       3641      0.497       0.49      0.485
0.323

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     24/100      6.85G      1.176      1.602      1.602         22        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]

                 all       2061       3641      0.455      0.516        0.5
0.343
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     25/100      6.86G      1.151      1.558      1.586         16        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.542       0.46      0.511
0.349

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     26/100      6.82G       1.13      1.521      1.565         21        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.542      0.505      0.517
0.35

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     27/100      6.84G      1.123      1.498      1.558         30        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.454      0.552      0.531
0.373

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     28/100      6.86G      1.107      1.477      1.545         23        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.498      0.521      0.537
0.377

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     29/100      6.85G      1.109      1.475      1.546         27        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.488      0.581      0.554
0.391

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
     30/100      6.84G      1.087      1.424      1.522         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]

                   all       2061       3641      0.531      0.536      0.542
0.382

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     31/100      6.88G      1.081      1.418       1.52         18        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641      0.471      0.578      0.565
0.402

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     32/100      6.86G      1.077      1.403      1.512         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641      0.549      0.554      0.552
0.39

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     33/100      6.85G      1.054      1.366      1.498         30        640:
100%|      | 389/389 [03:24<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641      0.532      0.575      0.574
0.397

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     34/100      6.84G      1.063      1.383      1.503         15        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641       0.59       0.57      0.579
0.407

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     35/100      6.87G       1.05      1.346      1.497         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
```

```
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.633       0.51       0.59
0.429

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     36/100      6.85G      1.035      1.333      1.484         23        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.623      0.564      0.603
0.442

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     37/100      6.85G      1.025      1.302      1.471         31        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.647      0.563      0.616
0.447

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     38/100      6.84G      1.028      1.296      1.473         28        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.591       0.56      0.595
0.436

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     39/100      6.87G      1.022      1.296      1.469         11        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.587       0.58      0.605
0.447

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     40/100      6.85G       1.01      1.276       1.46         26        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
```

```
                 all       2061       3641      0.591      0.628      0.626
0.465

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     41/100      6.87G      1.012      1.257      1.453         19        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                 all       2061       3641      0.579      0.632      0.634
0.466

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     42/100      6.81G     0.9933       1.24      1.444         15        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]

                 all       2061       3641      0.617      0.635       0.65
0.47

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     43/100      6.85G     0.9887      1.224      1.439         25        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]

                 all       2061       3641       0.63      0.583      0.635
0.463

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     44/100      6.86G     0.9829      1.207      1.432         26        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                 all       2061       3641      0.648      0.624       0.65
0.481

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     45/100      6.86G     0.9796      1.193      1.435         26        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]

                 all       2061       3641      0.661      0.613      0.654
0.486
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     46/100      6.82G     0.9735      1.206      1.426         21        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.659      0.631      0.656
0.482

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     47/100      6.87G     0.9542      1.169      1.411         11        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                   all       2061       3641      0.702      0.637      0.673
0.496

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     48/100      6.85G      0.958      1.164      1.414         24        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641       0.67      0.633      0.663
0.496

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     49/100      6.86G     0.9634      1.166      1.411         36        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.699      0.613      0.668
0.498

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     50/100      6.84G     0.9468       1.14      1.401         18        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.652      0.635      0.666
0.487

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
     51/100      6.85G     0.9417      1.132      1.396         10        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]

                   all       2061       3641      0.647      0.648      0.669
0.495

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     52/100      6.85G     0.9404      1.132      1.398         30        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]

                   all       2061       3641      0.694      0.612      0.666
0.503

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     53/100      6.85G     0.9315      1.111      1.382         24        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]

                   all       2061       3641      0.666      0.635      0.677
0.507

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     54/100      6.84G     0.9283      1.107       1.39         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]

                   all       2061       3641        0.7      0.637      0.678
0.502

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     55/100      6.84G     0.9154      1.083      1.373         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641      0.712      0.649      0.682
0.511

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     56/100      6.86G     0.9249      1.099      1.383         18        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
```

```
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.705       0.66       0.69
0.514

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     57/100      6.85G     0.9236      1.089      1.384         19        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641       0.68      0.654      0.677
0.503

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     58/100      6.82G     0.9081      1.073      1.369         46        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.692      0.627      0.676
0.506

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     59/100      6.84G     0.9022      1.055      1.362         21        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.689      0.624      0.685
0.516

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     60/100      6.85G     0.9078      1.057      1.369         41        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                   all       2061       3641      0.676      0.664      0.694
0.52

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     61/100      6.86G     0.8932      1.046      1.355         11        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
```

```
                 all       2061       3641      0.678      0.662      0.704
0.524

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     62/100      6.84G     0.8981       1.04      1.358         31        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                 all       2061       3641      0.743       0.65      0.708
0.528

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     63/100      6.87G     0.8797      1.013      1.339         25        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                 all       2061       3641      0.662      0.682      0.692
0.517

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     64/100      6.84G     0.8862      1.025      1.348         22        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                 all       2061       3641      0.708      0.678       0.71
0.53

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     65/100      6.86G     0.8802      1.008      1.335         20        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                 all       2061       3641      0.704      0.668      0.705
0.53

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     66/100      6.83G     0.8711      1.002      1.332         22        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                 all       2061       3641      0.704      0.663      0.696
0.53
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     67/100      6.86G     0.8612     0.9857      1.329         29        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.732      0.652      0.703
0.525

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     68/100      6.85G     0.8642     0.9837      1.329         25        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                   all       2061       3641      0.701      0.686      0.703
0.538

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     69/100      6.85G     0.8602     0.9865      1.326         16        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.764      0.669      0.711
0.54

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     70/100      6.81G     0.8462     0.9637       1.32         43        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.715      0.669       0.71
0.539

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     71/100      6.86G     0.8556     0.9754       1.32         26        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                   all       2061       3641      0.697      0.682      0.717
0.533

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
     72/100      6.85G     0.8497     0.9618      1.318         19        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641      0.714       0.67      0.719
0.54

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     73/100      6.85G     0.8554     0.9633      1.321         15        640:
100%|      | 389/389 [03:25<00:00,  1.89it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]

                   all       2061       3641      0.736      0.689      0.727
0.545

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     74/100      6.83G     0.8405     0.9467      1.311         31        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641      0.738      0.666      0.729
0.541

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     75/100      6.86G     0.8354     0.9432      1.311         16        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]

                   all       2061       3641      0.731      0.666      0.731
0.541

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     76/100      6.83G     0.8491     0.9451       1.31         30        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                   all       2061       3641      0.713      0.689      0.729
0.544

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     77/100      6.85G     0.8383     0.9314      1.309         34        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
```

```
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.51it/s]
                   all       2061       3641      0.745       0.69      0.731
0.554

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     78/100      6.84G     0.8288     0.9224      1.303         17        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.754      0.685      0.732
0.548

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     79/100      6.84G     0.8273     0.9237        1.3         29        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.733      0.685      0.728
0.555

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     80/100      6.86G     0.8279     0.9166      1.302         15        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.729        0.7       0.73
0.552

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     81/100      6.88G     0.8229     0.9169      1.295         21        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.717      0.697      0.724
0.556

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     82/100      6.84G     0.8198     0.9049      1.294         12        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
```

```
                 all       2061       3641      0.734      0.681      0.727
0.555

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     83/100      6.87G     0.8182     0.9001      1.292         17        640:
100%|      | 389/389 [03:25<00:00,  1.89it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]

                 all       2061       3641      0.753      0.695      0.734
0.559

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     84/100      6.85G     0.8125     0.8942       1.29         18        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                 all       2061       3641      0.729      0.698       0.73
0.562

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     85/100      6.86G     0.8078     0.8839      1.286         19        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]

                 all       2061       3641      0.735      0.702      0.738
0.559

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     86/100      6.81G     0.7997     0.8809      1.278         22        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]

                 all       2061       3641      0.751      0.697      0.727
0.556

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     87/100      6.84G     0.8089     0.8762      1.284         23        640:
100%|      | 389/389 [03:25<00:00,  1.89it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]

                 all       2061       3641      0.766      0.671      0.726
0.558
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     88/100      6.85G     0.7912     0.8649      1.272         19        640:
100%|      | 389/389 [03:25<00:00,  1.89it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                   all       2061       3641      0.787      0.676      0.732
0.559

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     89/100      6.85G     0.7928     0.8584      1.274         25        640:
100%|      | 389/389 [03:25<00:00,  1.89it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                   all       2061       3641      0.785      0.681      0.737
0.563

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     90/100      6.81G     0.7997     0.8632      1.272         19        640:
100%|      | 389/389 [03:25<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.789      0.671      0.736
0.563
Closing dataloader mosaic
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, num_output_channels=3,
method='weighted_average'), CLAHE(p=0.01, clip_limit=(1.0, 4.0),
tile_grid_size=(8, 8))

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     91/100      6.84G     0.7368     0.7453      1.263          5        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.49it/s]
                   all       2061       3641      0.767      0.689      0.737
0.566

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     92/100      6.85G     0.7231     0.7214      1.257         10        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
```

```
                 all       2061       3641      0.782      0.685      0.742
0.569

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     93/100      6.85G     0.6997     0.6973      1.232          9        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                 all       2061       3641      0.792       0.69      0.746
0.574

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     94/100      6.83G      0.703     0.6889      1.229         14        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                 all       2061       3641       0.79       0.69      0.746
0.576

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     95/100      6.86G     0.6982     0.6779      1.231         11        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                 all       2061       3641      0.754      0.703      0.749
0.58

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     96/100      6.85G     0.6854     0.6727       1.22         11        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                 all       2061       3641      0.777      0.699      0.751
0.582

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     97/100      6.85G     0.6799      0.667      1.217         12        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                 all       2061       3641      0.756      0.715       0.75
0.582
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     98/100      6.81G     0.6817     0.6645      1.221         17        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641       0.78      0.709      0.754
0.586


      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     99/100      6.85G     0.6808     0.6629      1.215          9        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:25<00:00,  2.50it/s]
                   all       2061       3641      0.782      0.702      0.755
0.586

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
    100/100      6.85G     0.6807      0.655      1.212          8        640:
100%|      | 389/389 [03:24<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.50it/s]
                   all       2061       3641      0.785      0.699      0.754
0.588

100 epochs completed in 6.448 hours.
Optimizer stripped from runs/detect/train/weights/last.pt, 18.7MB
Optimizer stripped from runs/detect/train/weights/best.pt, 18.7MB

Validating runs/detect/train/weights/best.pt…
Ultralytics 8.3.63  Python-3.10.12 torch-2.5.1+cu121 CUDA:0 (Tesla T4,
15095MiB)
YOLOv12s summary (fused): 376 layers, 9,080,400 parameters, 0 gradients, 19.3
GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100%|      | 65/65 [00:26<00:00,  2.48it/s]
                   all       2061       3641      0.783      0.701      0.754
0.588
             Aggressor         27         27      0.737      0.623      0.737
0.501
        Discussion_WGI         35         35      0.916          1      0.994
0.943
```

```
   Discussions_WOBoard         17         17      0.953          1      0.995
0.995
       Discussions_ppl        201        247      0.873      0.935       0.96
0.902
                  Hand         54         56      0.318      0.309      0.301
0.182
           Item_passed         35         35      0.927      0.363      0.554
0.232
          Knife_Deploy         27         27      0.466      0.667      0.593
0.303
          Knife_Weapon         54         74      0.748      0.338      0.384
0.221
           NonViolence        232        443      0.775      0.729      0.796
0.549
                Person        281        839      0.951      0.919      0.964
0.848
              Stabbing        173        174       0.93      0.989      0.989
0.852
                Victim         27         27      0.899      0.662      0.842
0.628
              Violence        480        496      0.794      0.764      0.845
0.575
         Writing_Board         17         17      0.894          1      0.995
0.987
                   gun        880       1081      0.715      0.358      0.478
0.237
                  hang         45         46      0.637      0.565      0.631
0.452

invalid value encountered in less
invalid value encountered in less

Speed: 0.2ms preprocess, 9.2ms inference, 0.0ms loss, 0.8ms postprocess per
image
Results saved to runs/detect/train
```

0.4 Evaluate fine-tuned YOLOv12 model

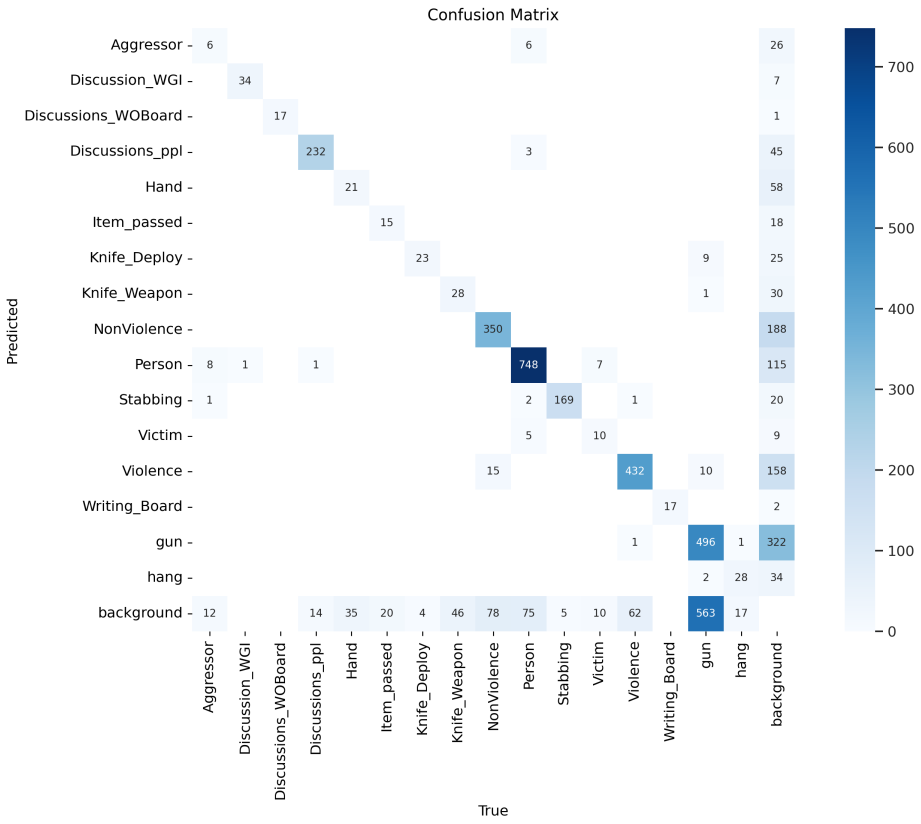
[48]:
```
import locale
locale.getpreferredencoding = lambda: "UTF-8"

!ls {HOME}/runs/detect/train/
```

```
args.yaml                                       train_batch1.jpg
confusion_matrix_normalized.png                 train_batch2.jpg
confusion_matrix.png                            train_batch35010.jpg
events.out.tfevents.1742612098.2000c1d5ec53.31.0 train_batch35011.jpg
F1_curve.png                                    train_batch35012.jpg
labels_correlogram.jpg                          val_batch0_labels.jpg
```

```
labels.jpg                                  val_batch0_pred.jpg
P_curve.png                                 val_batch1_labels.jpg
PR_curve.png                                val_batch1_pred.jpg
R_curve.png                                 val_batch2_labels.jpg
results.csv                                 val_batch2_pred.jpg
results.png                                 weights
train_batch0.jpg
```

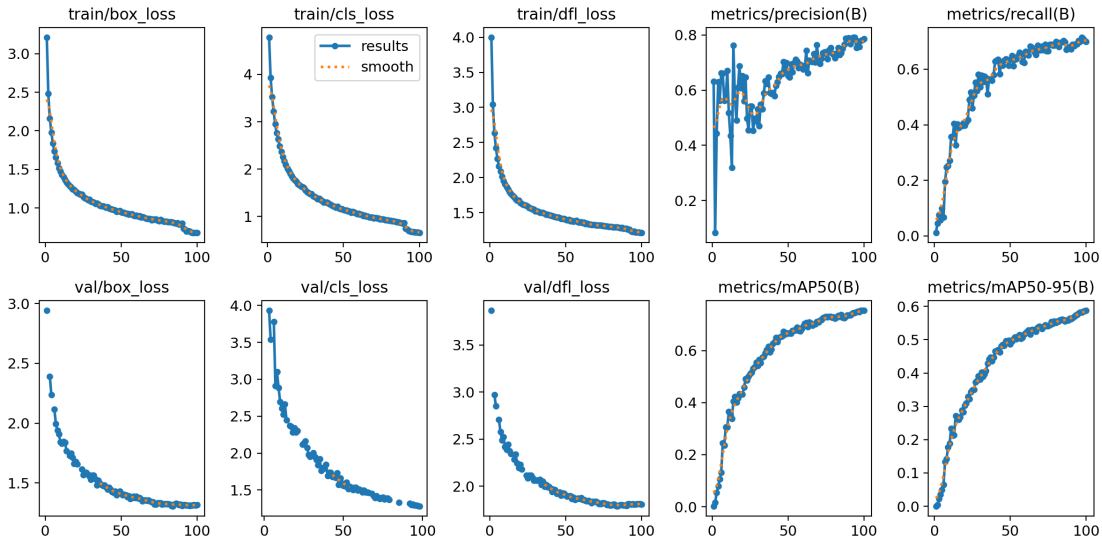
[49]:
```
from IPython.display import Image

Image(filename=f'{HOME}/runs/detect/train/confusion_matrix.png', width=1000)
```

[49]:



[50]:
```
from IPython.display import Image

Image(filename=f'{HOME}/runs/detect/train/results.png', width=1000)
```

[50]:



[51]:
```
import supervision as sv

ds = sv.DetectionDataset.from_yolo(
    images_directory_path=f"{dataset.location}/test/images",
    annotations_directory_path=f"{dataset.location}/test/labels",
    data_yaml_path=f"{dataset.location}/data.yaml"
)

ds.classes
```

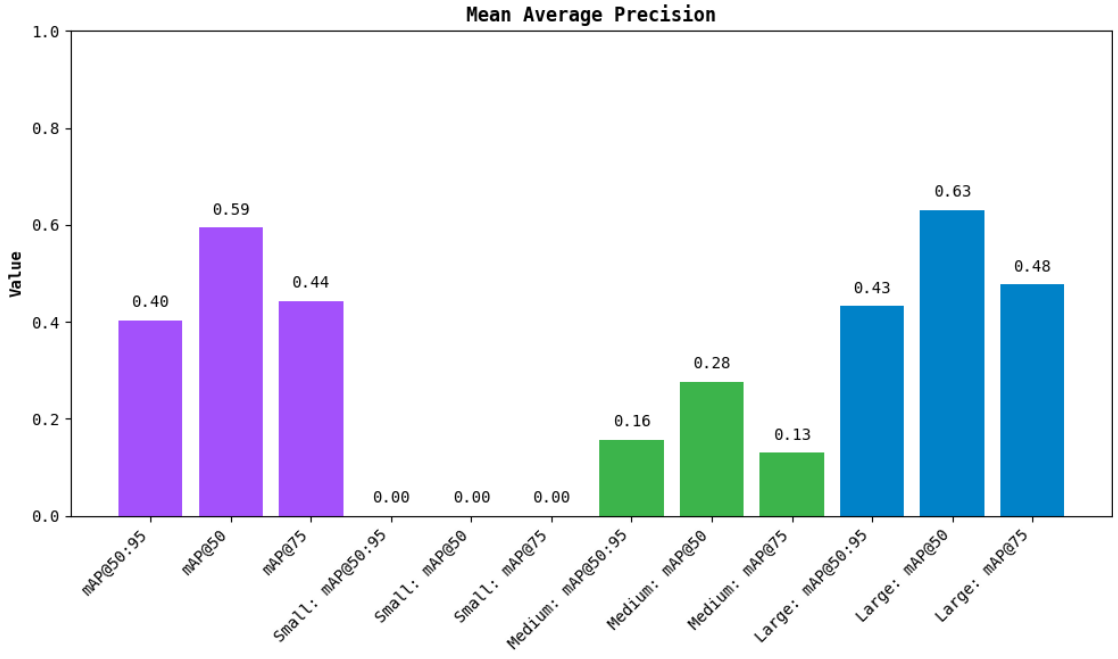
[51]:
```
['Aggressor',
 'Discussion_WGI',
 'Discussions_WOBoard',
 'Discussions_ppl',
 'Hand',
 'Item_passed',
 'Knife_Deploy',
 'Knife_Weapon',
 'NonViolence',
 'Person',
 'Stabbing',
 'Victim',
 'Violence',
 'Writing_Board',
 'gun',
 'hang']
```

[52]:
```
from supervision.metrics import MeanAveragePrecision

model = YOLO(f'/{HOME}/runs/detect/train/weights/best.pt')

predictions = []
targets = []

for _, image, target in ds:
    results = model(image, verbose=False)[0]
    detections = sv.Detections.from_ultralytics(results)

    predictions.append(detections)
    targets.append(target)

map = MeanAveragePrecision().update(predictions, targets).compute()
```

[53]:
```
print("mAP 50:95", map.map50_95)
print("mAP 50", map.map50)
print("mAP 75", map.map75)
```

```
mAP 50:95 0.40334982188854684
mAP 50 0.5948772490102415
mAP 75 0.44362164674105425
```

[54]:
```
map.plot()
```



0.5 Run inference with fine-tuned YOLOv12 model

[55]:
```
import supervision as sv

model = YOLO(f'/{HOME}/runs/detect/train/weights/best.pt')

ds = sv.DetectionDataset.from_yolo(
    images_directory_path=f"{dataset.location}/test/images",
    annotations_directory_path=f"{dataset.location}/test/labels",
    data_yaml_path=f"{dataset.location}/data.yaml"
)
```

[56]:
```
import random

i = random.randint(0, len(ds))

image_path, image, target = ds[i]

results = model(image, verbose=False)[0]
detections = sv.Detections.from_ultralytics(results).with_nms()

box_annotator = sv.BoxAnnotator()
label_annotator = sv.LabelAnnotator()

annotated_image = image.copy()
annotated_image = box_annotator.annotate(scene=annotated_image,␣
 ↪detections=detections)
annotated_image = label_annotator.annotate(scene=annotated_image,␣
 ↪detections=detections)

sv.plot_image(annotated_image)
```


gun