Assignment_02 [MD SIFAT ULLAH SHEIKH, 2022-1-60-029]

```
                                        Overview Work Pipeline
```

 1. Label Conversion At first I need to convert the Pascal VOC XML format, which is an XML file with bounding box coordinates in pixel values, to the YOLO format. The YOLO format is a simple .txt file with one line per object, each containing the class_id, followed by the normalized center_x, center_y, width, and height of the bounding box.

 2. Dataset Setup Organize the dataset into a specific folder structure that YOLO models can easily work with. This involves creating a main directory (e.g., dataset/) with subfolders for images and labels, each containing train/, val/, and test/ splits. You also need a data.yaml file that specifies the paths to these folders and lists your class names.

 3. Model Training You can train a **YOLOv8** or **YOLOv12** model using the command-line interface. Use key hyperparameters like epochs and batch_size, and implement early-stopping with the patience argument to prevent overfitting. This will stop the training if the model's performance on the validation set doesn't improve for a set number of epochs.

 4. Visualization and Predictions After training, the model automatically generates visualizations in the runs/ directory, showing metrics like accuracy and loss over time. To see how your model performs on new data, you can run a prediction on your test images. This will produce images with bounding boxes and class labels, letting you visually inspect the results.

Import the important components

```
import os, sys, subprocess, shlex, glob
from pathlib import Path


OFFLINE_WHEELS_DIR = Path("/kaggle/input/ultralytics-wheels")

def pip_install(cmd: str):
    print(f"Installing: {cmd}")
    rc = subprocess.call(shlex.split(cmd))
    print("Return code:", rc)
    return rc

def ensure_ultralytics():
    try:
        import ultralytics
        return True
    except Exception:
        pass
```

```
    rc = pip_install("pip install ultralytics==8.3.78 lxml opencv-
python --quiet")
    if rc == 0:
        return True


    if OFFLINE_WHEELS_DIR and OFFLINE_WHEELS_DIR.exists():
        wheels = sorted(glob.glob(str(OFFLINE_WHEELS_DIR / "*.whl")))
        if wheels:
            rc = pip_install(f"pip install --no-index --find-links
{OFFLINE_WHEELS_DIR} " +
                             " ".join(wheels))
            if rc == 0:
                return True

    return False

ok = ensure_ultralytics()
if not ok:
    raise RuntimeError(
        "Ultralytics could not be installed. If you are offline,
upload a dataset of "
        "wheels (ultralytics + deps) to Kaggle and set
OFFLINE_WHEELS_DIR above."
    )
```

```
Installing: pip install ultralytics==8.3.78 lxml opencv-python --quiet
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 921.5/921.5 kB 4.5 MB/s
eta 0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 363.4/363.4 MB 4.5 MB/s
eta 0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 13.8/13.8 MB 40.1 MB/s eta
0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 24.6/24.6 MB 45.2 MB/s eta
0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 883.7/883.7 kB 39.6 MB/s
eta 0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 664.8/664.8 MB 2.4 MB/s
eta 0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 211.5/211.5 MB 7.4 MB/s
eta 0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 56.3/56.3 MB 24.0 MB/s eta
0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 127.9/127.9 MB 8.0 MB/s
eta 0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 207.5/207.5 MB 7.0 MB/s
eta 0:00:00
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 21.1/21.1 MB 4.3 MB/s eta
```

```
0:00:00
Return code: 0
```

```
from ultralytics import YOLO
import xml.etree.ElementTree as ET
import random, shutil, math, json, yaml
import numpy as np
import pandas as pd
import cv2
import matplotlib.pyplot as plt
import seaborn as sns
from tqdm.auto import tqdm

sns.set_context("talk"); sns.set_style("whitegrid")
plt.rcParams["figure.figsize"] = (12, 7)

SEED = 42
random.seed(SEED); np.random.seed(SEED)
```

```
Creating new Ultralytics Settings v0.0.6 file □
View Ultralytics Settings with 'yolo settings' or at
'/root/.config/Ultralytics/settings.json'
Update Settings with 'yolo settings key=value', i.e. 'yolo settings
runs_dir=path/to/dir'. For help see
https://docs.ultralytics.com/quickstart/#ultralytics-settings.
```

Dataset path setup

```
DATASET_ROOT = Path("/kaggle/input/drone-images-for-military-object-
detection")
TRAIN_IMG_DIR = DATASET_ROOT / "train" / "images"
TRAIN_ANN_DIR = DATASET_ROOT / "train" / "annotations"
TEST_IMG_DIR  = DATASET_ROOT / "test"  / "images"
TEST_ANN_DIR  = DATASET_ROOT / "test"  / "annotations"

WORK_DIR   = Path("/kaggle/working")
YOLO_DATA  = WORK_DIR / "yolo_data"     # where we put YOLO-ready data
YOLO_DATA.mkdir(parents=True, exist_ok=True)

print("Dataset exists:", DATASET_ROOT.exists())
print("Train images dir:", TRAIN_IMG_DIR)
print("Train ann dir   :", TRAIN_ANN_DIR)
print("Test images dir :", TEST_IMG_DIR)
print("Test ann dir    :", TEST_ANN_DIR, " (exists:",
TEST_ANN_DIR.exists(), ")")
```

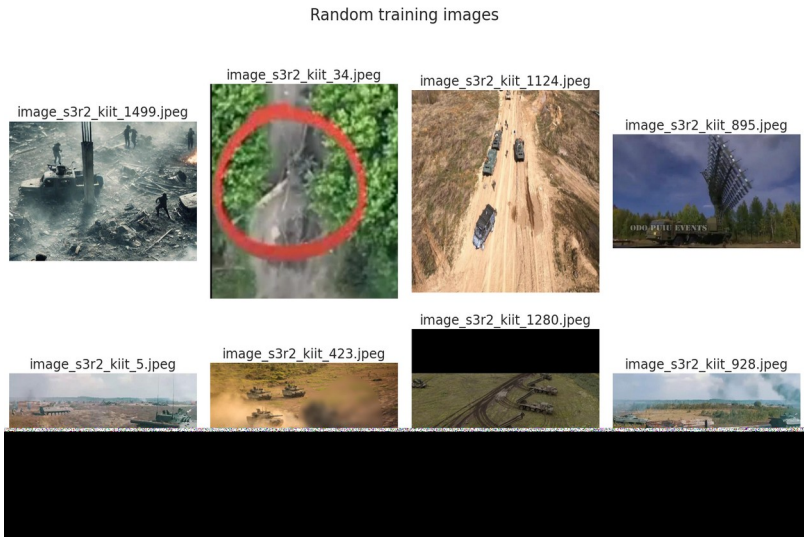
```
Dataset exists: True
Train images dir: /kaggle/input/drone-images-for-military-object-detection/train/images
Train ann dir   : /kaggle/input/drone-images-for-military-object-detection/train/annotations
Test images dir : /kaggle/input/drone-images-for-military-object-detection/test/images
Test ann dir    : /kaggle/input/drone-images-for-military-object-detection/test/annotations  (exists: True )
```

EDA

```
IMG_EXTS = {".jpg", ".jpeg", ".png", ".bmp", ".tif", ".tiff", ".webp"}

def read_xml_classes(xml_path: Path):
    tree = ET.parse(xml_path)
    root = tree.getroot()
    names = []
    for obj in root.findall("object"):
        name = obj.findtext("name")
        if name: names.append(name.strip())
    return names


xml_files = sorted(TRAIN_ANN_DIR.glob("*.xml"))
assert xml_files, f"No XML files found under {TRAIN_ANN_DIR}"
class_set = set()
for x in tqdm(xml_files, desc="Scanning classes"):
    for n in read_xml_classes(x):
        class_set.add(n)

classes = sorted(class_set)
name2id = {n:i for i,n in enumerate(classes)}
print("Classes:", classes)
print("num_classes:", len(classes))


train_images = [p for p in TRAIN_IMG_DIR.glob("*") if p.suffix.lower() in IMG_EXTS]
sample_show = min(8, len(train_images))
plt.figure(figsize=(16, 10))
for i, p in enumerate(random.sample(train_images, sample_show)):
    img = cv2.cvtColor(cv2.imread(str(p)), cv2.COLOR_BGR2RGB)
    plt.subplot(2, math.ceil(sample_show/2), i+1)
    plt.imshow(img); plt.axis("off"); plt.title(p.name[:28])
plt.suptitle("Random training images", y=1.02)
plt.tight_layout(); plt.show()
```

{"model_id":"254ff182eb254732b7bd06c3de498024","version_major":2,"version_minor":0}

```
Classes: ['Artilary', 'M. Rocket Launcher', 'Missile', 'Radar', 'Soldier', 'Tank', 'Vehicle']
num_classes: 7
```



Split the train dataset

```
def voc_to_yolo(size_wh, box_xyxy):
    w, h = size_wh
    xmin, ymin, xmax, ymax = box_xyxy

    x_c = (xmin + xmax) / 2.0 / w
    y_c = (ymin + ymax) / 2.0 / h
    bw  = (xmax - xmin) / w
    bh  = (ymax - ymin) / h

    x_c = min(max(x_c, 0.0), 1.0)
    y_c = min(max(y_c, 0.0), 1.0)
    bw  = min(max(bw , 0.0), 1.0)
    bh  = min(max(bh , 0.0), 1.0)
    return x_c, y_c, bw, bh

def convert_one(xml_path: Path, out_txt: Path):
    tree = ET.parse(xml_path)
    root = tree.getroot()
    W = int(root.findtext("size/width"))
    H = int(root.findtext("size/height"))
    lines = []
    for obj in root.findall("object"):
```

```
        name = obj.findtext("name").strip()
        if name not in name2id:
            continue
        cls_id = name2id[name]
        bb = obj.find("bndbox")
        xmin = float(bb.findtext("xmin")); ymin =
float(bb.findtext("ymin"))
        xmax = float(bb.findtext("xmax")); ymax =
float(bb.findtext("ymax"))
        x,y,w,h = voc_to_yolo((W,H), (xmin,ymin,xmax,ymax))
        lines.append(f"{cls_id} {x:.6f} {y:.6f} {w:.6f} {h:.6f}")
    out_txt.parent.mkdir(parents=True, exist_ok=True)
    with open(out_txt, "w") as f:
        f.write("\n".join(lines))

def link_copy(src: Path, dst: Path):
    dst.parent.mkdir(parents=True, exist_ok=True)
    try:
        os.link(src, dst)
    except Exception:
        try:
            os.symlink(src, dst)
        except Exception:
            shutil.copy2(src, dst)


for split in ["train", "val", "test"]:
    (YOLO_DATA / f"images/{split}").mkdir(parents=True, exist_ok=True)
    if split != "test":
        (YOLO_DATA / f"labels/{split}").mkdir(parents=True,
exist_ok=True)


all_train_imgs = sorted([p for p in TRAIN_IMG_DIR.glob("*") if
p.suffix.lower() in IMG_EXTS])
random.shuffle(all_train_imgs)
VAL_RATIO = 0.15
n_val = max(1, int(len(all_train_imgs) * VAL_RATIO))
val_set  = set(all_train_imgs[:n_val])
train_set= set(all_train_imgs[n_val:])


for img in tqdm(train_set, desc="Convert: train"):
    xml = TRAIN_ANN_DIR / f"{img.stem}.xml"
    if not xml.exists():
        continue
    link_copy(img, YOLO_DATA / f"images/train/{img.name}")
    convert_one(xml, YOLO_DATA / f"labels/train/{img.stem}.txt")

for img in tqdm(val_set, desc="Convert: val"):
```

```
    xml = TRAIN_ANN_DIR / f"{img.stem}.xml"
    if not xml.exists():
        continue
    link_copy(img, YOLO_DATA / f"images/val/{img.name}")
    convert_one(xml, YOLO_DATA / f"labels/val/{img.stem}.txt")


test_imgs = sorted([p for p in TEST_IMG_DIR.glob("*") if
p.suffix.lower() in IMG_EXTS])
for img in tqdm(test_imgs, desc="Prepare: test"):
    link_copy(img, YOLO_DATA / f"images/test/{img.name}")
    test_xml = TEST_ANN_DIR / f"{img.stem}.xml"
    if test_xml.exists():
        convert_one(test_xml, YOLO_DATA /
f"labels/test/{img.stem}.txt")  # only used if you run .val on test

print("Counts:",
      "train", len(list((YOLO_DATA/'images/train').glob('*'))),
      "val",   len(list((YOLO_DATA/'images/val').glob('*'))),
      "test",  len(list((YOLO_DATA/'images/test').glob('*'))))
```


```
{"model_id":"c51f50a8c7484ccab37d64fafd9fcf35","version_major":2,"vers
ion_minor":0}

{"model_id":"07ee64dd60564d62821fa4ea6fa76558","version_major":2,"vers
ion_minor":0}

{"model_id":"5d471b4bda054a7bb2c1dc13ae686842","version_major":2,"vers
ion_minor":0}
```


```
Counts: train 1301 val 229 test 170
```

Level of class and EDA

```
DATA_YAML = YOLO_DATA / "data.yaml"
yaml_dict = {
    "path": str(YOLO_DATA),
    "train": "images/train",
    "val":   "images/val",
    "test":  "images/test",
    "names": classes
}
with open(DATA_YAML, "w") as f:
    yaml.safe_dump(yaml_dict, f, sort_keys=False)

print("Wrote:", DATA_YAML)
print(yaml.safe_dump(yaml_dict, sort_keys=False))
```

```python
def read_labels(lbl_dir: Path):
    counts = np.zeros(len(classes), dtype=int)
    for txt in lbl_dir.glob("*.txt"):
        with open(txt) as f:
            for line in f:
                line=line.strip()
                if not line: continue
                cls = int(line.split()[0])
                counts[cls] += 1
    return counts

train_counts = read_labels(YOLO_DATA / "labels/train")
plt.figure()
plt.bar(range(len(classes)), train_counts)
plt.xticks(range(len(classes)), classes, rotation=45, ha="right")
plt.title("Training label count per class")
plt.tight_layout(); plt.show()
```

```
Wrote: /kaggle/working/yolo_data/data.yaml
path: /kaggle/working/yolo_data
train: images/train
val: images/val
test: images/test
names:
- Artilary
- M. Rocket Launcher
- Missile
- Radar
- Soldier
- Tank
- Vehicle
```

YOLOv8 Train

```
RUN8 = "yolov8s_drone"
EPOCHS   = 100
IMGSZ    = 640
BATCH    = -1
PATIENCE = 30


try:
    model8 = YOLO("yolov8s.pt")
except Exception as e:
    print("Could not load yolov8s.pt, training from scratch:", e)
    model8 = YOLO("yolov8s.yaml")

res8 = model8.train(
    data=str(DATA_YAML),
    epochs=EPOCHS,
    imgsz=IMGSZ,
    batch=BATCH,
    device=0,
    workers=2,
    project="runs/detect",
    name=RUN8,
    verbose=True,
```

```
    patience=PATIENCE,

    optimizer="AdamW",
    lr0=0.003,
    lrf=0.12,
    weight_decay=5e-4,
    warmup_epochs=3,
    cos_lr=True,

    degrees=5.0, translate=0.10, scale=0.9, shear=2.0,
    fliplr=0.5, flipud=0.0,
    mosaic=1.0, mixup=0.10,
    erasing=0.0, copy_paste=0.0,
    close_mosaic=10,
    amp=True
)

Downloading
https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov8s
.pt to 'yolov8s.pt'...

100%|██████████| 21.5M/21.5M [00:00<00:00, 32.7MB/s]

New https://pypi.org/project/ultralytics/8.3.178 available 😄 Update
with 'pip install -U ultralytics'
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)
engine/trainer: task=detect, mode=train, model=yolov8s.pt,
data=/kaggle/working/yolo_data/data.yaml, epochs=100, time=None,
patience=30, batch=-1, imgsz=640, save=True, save_period=-1,
cache=False, device=0, workers=2, project=runs/detect,
name=yolov8s_drone, exist_ok=False, pretrained=True, optimizer=AdamW,
verbose=True, seed=0, deterministic=True, single_cls=False,
rect=False, cos_lr=True, 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=0.003, lrf=0.12, momentum=0.937, weight_decay=0.0005,
warmup_epochs=3, warmup_momentum=0.8, warmup_bias_lr=0.1, 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=5.0, translate=0.1, scale=0.9, shear=2.0,
perspective=0.0, flipud=0.0, fliplr=0.5, bgr=0.0, mosaic=1.0,
mixup=0.1, copy_paste=0.0, copy_paste_mode=flip,
```

```
auto_augment=randaugment, erasing=0.0, crop_fraction=1.0, cfg=None,
tracker=botsort.yaml, save_dir=runs/detect/yolov8s_drone
Downloading https://ultralytics.com/assets/Arial.ttf to
'/root/.config/Ultralytics/Arial.ttf'...

100%|██████████| 755k/755k [00:00<00:00, 3.80MB/s]
WARNING: All log messages before absl::InitializeLog() is called are
written to STDERR
E0000 00:00:1755094235.943360      36 cuda_dnn.cc:8310] Unable to
register cuDNN factory: Attempting to register factory for plugin
cuDNN when one has already been registered
E0000 00:00:1755094236.001277      36 cuda_blas.cc:1418] Unable to
register cuBLAS factory: Attempting to register factory for plugin
cuBLAS when one has already been registered

Overriding model.yaml nc=80 with nc=7

                   from  n    params  module
arguments
  0                  -1  1       928  ultralytics.nn.modules.conv.Conv
[3, 32, 3, 2]
  1                  -1  1     18560  ultralytics.nn.modules.conv.Conv
[32, 64, 3, 2]
  2                  -1  1     29056  ultralytics.nn.modules.block.C2f
[64, 64, 1, True]
  3                  -1  1     73984  ultralytics.nn.modules.conv.Conv
[64, 128, 3, 2]
  4                  -1  2    197632  ultralytics.nn.modules.block.C2f
[128, 128, 2, True]
  5                  -1  1    295424  ultralytics.nn.modules.conv.Conv
[128, 256, 3, 2]
  6                  -1  2    788480  ultralytics.nn.modules.block.C2f
[256, 256, 2, True]
  7                  -1  1   1180672  ultralytics.nn.modules.conv.Conv
[256, 512, 3, 2]
  8                  -1  1   1838080  ultralytics.nn.modules.block.C2f
[512, 512, 1, True]
  9                  -1  1    656896
ultralytics.nn.modules.block.SPPF            [512, 512, 5]

 10                  -1  1         0
torch.nn.modules.upsampling.Upsample         [None, 2, 'nearest']

 11             [-1, 6]  1         0
ultralytics.nn.modules.conv.Concat           [1]

 12                  -1  1    591360  ultralytics.nn.modules.block.C2f
[768, 256, 1]
 13                  -1  1         0
torch.nn.modules.upsampling.Upsample         [None, 2, 'nearest']
```

```
 14             [-1, 4]  1         0
ultralytics.nn.modules.conv.Concat           [1]

 15                   -1  1    148224  ultralytics.nn.modules.block.C2f
[384, 128, 1]
 16                   -1  1    147712  ultralytics.nn.modules.conv.Conv
[128, 128, 3, 2]
 17            [-1, 12]  1         0
ultralytics.nn.modules.conv.Concat           [1]

 18                   -1  1    493056  ultralytics.nn.modules.block.C2f
[384, 256, 1]
 19                   -1  1    590336  ultralytics.nn.modules.conv.Conv
[256, 256, 3, 2]
 20             [-1, 9]  1         0
ultralytics.nn.modules.conv.Concat           [1]

 21                   -1  1   1969152  ultralytics.nn.modules.block.C2f
[768, 512, 1]
 22        [15, 18, 21]  1   2118757
ultralytics.nn.modules.head.Detect           [7, [128, 256, 512]]

Model summary: 129 layers, 11,138,309 parameters, 11,138,293
gradients, 28.7 GFLOPs

Transferred 349/355 items from pretrained weights
TensorBoard: Start with 'tensorboard --logdir
runs/detect/yolov8s_drone', view at http://localhost:6006/
Freezing layer 'model.22.dfl.conv.weight'
AMP: running Automatic Mixed Precision (AMP) checks...
Downloading
https://github.com/ultralytics/assets/releases/download/v8.3.0/yolo11n
.pt to 'yolo11n.pt'...

100%|██████████| 5.35M/5.35M [00:00<00:00, 15.6MB/s]

AMP: checks passed 

train: Scanning /kaggle/working/yolo_data/labels/train... 1301 images,
0 backgrounds, 0 corrupt: 100%|██████████| 1301/1301 [00:02<00:00,
639.69it/s]

train: New cache created: /kaggle/working/yolo_data/labels/train.cache
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average',
num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0),
tile_grid_size=(8, 8))
AutoBatch: Computing optimal batch size for imgsz=640 at 60.0% CUDA
memory utilization.
AutoBatch: CUDA:0 (Tesla P100-PCIE-16GB) 15.89G total, 0.15G reserved,
```

```
0.14G allocated, 15.60G free
      Params      GFLOPs  GPU_mem (GB)  forward (ms) backward (ms)
input                 output
    11138309       28.66         0.879         34.48         151.4
(1, 3, 640, 640)                   list
    11138309       57.32         1.166         23.52          77.5
(2, 3, 640, 640)                   list
    11138309       114.6         1.883         27.08         126.2
(4, 3, 640, 640)                   list
    11138309       229.3         3.118          44.4         119.1
(8, 3, 640, 640)                   list
    11138309       458.6         5.826         85.44         196.2
(16, 3, 640, 640)                   list
AutoBatch: Using batch-size 37 for CUDA:0 9.69G/15.89G (61%) 

train: Scanning /kaggle/working/yolo_data/labels/train.cache... 1301
images, 0 backgrounds, 0 corrupt: 100%|██████████| 1301/1301 [00:00<?,
?it/s]

albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average',
num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0),
tile_grid_size=(8, 8))


val: Scanning /kaggle/working/yolo_data/labels/val... 229 images, 0
backgrounds, 0 corrupt: 100%|██████████| 229/229 [00:00<00:00,
603.93it/s]

val: New cache created: /kaggle/working/yolo_data/labels/val.cache



Plotting labels to runs/detect/yolov8s_drone/labels.jpg...
optimizer: AdamW(lr=0.003, momentum=0.937) with parameter groups 57
weight(decay=0.0), 64 weight(decay=0.000578125), 63 bias(decay=0.0)
TensorBoard: model graph visualization added 
Image sizes 640 train, 640 val
Using 2 dataloader workers
Logging results to runs/detect/yolov8s_drone
Starting training for 100 epochs...

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      1/100      9.18G      1.708      4.037      1.522         47
640: 100%|██████████| 36/36 [00:23<00:00,  1.51it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:04<00:00,  1.07s/it]
```

```
                   all        229        639      0.143     0.0608
0.000184    5.4e-05



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      2/100      9.12G      1.881      2.775      1.698         28
640: 100%|██████████| 36/36 [00:23<00:00,  1.56it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:07<00:00,  1.95s/it]

                   all        229        639   0.000456     0.0754
0.000294   9.19e-05



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      3/100      9.13G      1.904      2.721      1.753         20
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:04<00:00,  1.16s/it]

                   all        229        639     0.0318      0.233
0.0102    0.00368



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      4/100      9.13G      1.846      2.647      1.702         51
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.22it/s]

                   all        229        639       0.15      0.315
0.0722     0.0294



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      5/100      9.13G      1.837      2.582      1.683         40
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.14it/s]

                   all        229        639      0.308       0.24
0.103     0.0457



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      6/100      9.15G      1.792      2.513      1.649         63
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.17it/s]

                   all        229        639      0.192       0.25
0.132     0.0576



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      7/100      9.13G      1.725      2.441      1.625         31
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:02<00:00,  1.97it/s]

                   all        229        639      0.315      0.259
0.167     0.0794



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      8/100      9.12G      1.741      2.389       1.62         38
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:02<00:00,  1.96it/s]

                   all        229        639      0.178      0.263
0.178     0.0836



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
      9/100      9.12G      1.699      2.366      1.581          16
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.29it/s]

                   all        229        639      0.278      0.265
0.216      0.107



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     10/100      9.12G      1.673      2.276       1.56          19
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.27it/s]

                   all        229        639      0.386      0.331
0.233      0.118



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     11/100      9.12G      1.687      2.231      1.553          37
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.25it/s]

                   all        229        639      0.245      0.374
0.283       0.14



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     12/100      9.13G      1.669      2.242      1.568          23
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.18it/s]

                   all        229        639      0.274      0.275
0.205     0.0951
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     13/100      9.12G      1.643      2.132      1.543         52
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.10it/s]

                   all        229        639      0.316      0.314
0.246      0.119



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     14/100      9.13G      1.614      2.136       1.53         55
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.25it/s]

                   all        229        639        0.3      0.391
0.297      0.144



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     15/100      9.12G       1.58      2.105      1.511         29
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.33it/s]

                   all        229        639      0.298      0.408
0.307       0.16



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     16/100      9.12G      1.612      2.161      1.522         42
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.24it/s]

                   all        229        639      0.337      0.385
0.317      0.164
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     17/100      9.12G       1.59      2.116      1.504         19
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.24it/s]

                   all        229        639      0.333       0.39
0.32      0.168



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     18/100      9.12G      1.565      2.008       1.48         32
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.21it/s]

                   all        229        639      0.351      0.354
0.327      0.168



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     19/100      9.13G      1.543      2.014      1.471         40
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.27it/s]

                   all        229        639       0.34      0.373
0.336      0.178



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     20/100      9.12G      1.526      1.989      1.473         34
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.23it/s]
```

```
                   all        229        639      0.328      0.419
0.331      0.169



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     21/100      9.13G      1.539      1.954       1.47         38
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.22it/s]

                   all        229        639      0.322      0.424
0.343       0.18



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     22/100      9.12G      1.561      1.987      1.468         29
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.38it/s]

                   all        229        639      0.385      0.362
0.344      0.191



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     23/100      9.13G      1.508      1.923      1.451         25
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.27it/s]

                   all        229        639      0.368      0.389
0.357      0.187



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     24/100      9.12G      1.529      1.946      1.469         23
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.34it/s]

                   all        229        639      0.416       0.35
0.334      0.168



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     25/100      9.12G      1.533      1.937      1.458         36
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.27it/s]

                   all        229        639       0.28      0.385
0.319      0.167



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     26/100      9.12G      1.496      1.867      1.438         49
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.28it/s]

                   all        229        639      0.411      0.431
0.393      0.216



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     27/100      9.12G      1.477      1.846      1.428         32
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.30it/s]

                   all        229        639       0.36      0.453
0.369      0.199



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     28/100      9.13G      1.482      1.819      1.426          28
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639      0.403      0.443
0.391       0.21



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     29/100      9.12G       1.48      1.804      1.416          29
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]

                   all        229        639      0.375      0.434
0.395      0.226



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     30/100      9.12G      1.454       1.76      1.398          33
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.28it/s]

                   all        229        639      0.519      0.385
0.393      0.209



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     31/100      9.12G       1.46      1.798      1.418          24
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639      0.433      0.468
0.423      0.216
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     32/100      9.13G      1.409      1.733      1.403         26
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.05it/s]

                   all        229        639      0.419      0.487
0.435      0.243



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     33/100      9.13G      1.439      1.732      1.393         42
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]

                   all        229        639      0.414      0.451
0.422      0.224



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     34/100      9.13G      1.438      1.716      1.397         40
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.37it/s]

                   all        229        639      0.486       0.47
0.457      0.254



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     35/100      9.13G       1.43      1.713      1.378         38
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.22it/s]

                   all        229        639      0.433      0.439
0.414       0.23
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     36/100      9.13G      1.428      1.713       1.39         39
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.26it/s]

                   all        229        639      0.366      0.528
0.435      0.243



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     37/100      9.12G      1.408      1.657      1.386         30
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.12it/s]

                   all        229        639      0.506      0.428
0.45      0.251



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     38/100      9.12G      1.427      1.658      1.369         57
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.42it/s]

                   all        229        639      0.475       0.43
0.454      0.253



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     39/100      9.13G      1.392      1.639      1.361         23
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]
```

```
                   all        229        639      0.504      0.487
0.484      0.275



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     40/100      9.13G      1.412      1.646      1.368         46
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.25it/s]

                   all        229        639       0.44       0.52
0.481      0.271



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     41/100      9.13G      1.394      1.614       1.36         20
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.42it/s]

                   all        229        639       0.48      0.432
0.471      0.267



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     42/100      9.12G      1.381      1.621      1.364         30
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.31it/s]

                   all        229        639      0.468      0.519
0.479      0.282



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     43/100      9.13G      1.395      1.588      1.362         24
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]

                   all        229        639        0.5      0.505
0.508      0.276



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     44/100      9.12G      1.377      1.548      1.355         20
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.25it/s]

                   all        229        639      0.479      0.483
0.471       0.26



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     45/100      9.13G      1.367      1.575       1.35         27
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639      0.526      0.546
0.537      0.294



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     46/100      9.12G       1.36      1.529      1.337         19
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.30it/s]

                   all        229        639      0.515      0.585
0.567      0.319



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     47/100      9.12G      1.376      1.527      1.358         30
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.33it/s]

                   all        229        639      0.473      0.537
0.502      0.287



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     48/100      9.12G      1.361      1.554      1.355         37
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.31it/s]

                   all        229        639      0.529      0.568
0.535      0.313



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     49/100      9.12G       1.34      1.507      1.307         24
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.41it/s]

                   all        229        639       0.46      0.574
0.513      0.303



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     50/100      9.13G       1.32      1.493      1.323         36
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.26it/s]

                   all        229        639      0.515      0.542
0.548      0.317
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     51/100      9.12G      1.306      1.442      1.307         22
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.11it/s]

                   all        229        639      0.466      0.568
0.529      0.299



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     52/100      9.13G      1.331      1.463      1.313         29
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.32it/s]

                   all        229        639      0.468      0.597
0.552      0.316



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     53/100      9.12G      1.341      1.414      1.298         78
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.31it/s]

                   all        229        639      0.583      0.527
0.565      0.316



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     54/100      9.13G       1.31      1.417      1.297         52
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639        0.5      0.593
0.568      0.321
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     55/100      9.12G      1.298      1.401      1.281         37
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.26it/s]

                   all        229        639      0.531       0.58
0.558       0.32



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     56/100      9.12G       1.31       1.41      1.291         46
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.17it/s]

                   all        229        639      0.448       0.62
0.548       0.32



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     57/100      9.12G      1.303      1.392      1.293         35
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.34it/s]

                   all        229        639      0.556      0.587
0.586      0.336



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     58/100      9.12G      1.292      1.377      1.282         29
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.38it/s]
```

```
                   all        229        639      0.514      0.604
0.556      0.324



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     59/100      9.13G      1.286      1.381      1.295         51
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.30it/s]

                   all        229        639      0.563      0.578
0.58      0.325



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     60/100      9.12G      1.282      1.347      1.272         42
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.34it/s]

                   all        229        639      0.563      0.578
0.608      0.358



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     61/100      9.12G      1.279      1.396      1.281         35
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.29it/s]

                   all        229        639      0.542      0.576
0.573      0.337



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     62/100      9.12G      1.281      1.339      1.278         20
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.31it/s]

                   all        229        639      0.607      0.564
0.586      0.338



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     63/100      9.13G      1.256      1.312      1.263         36
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.31it/s]

                   all        229        639      0.517      0.625
0.576      0.324



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     64/100      9.13G       1.27      1.341      1.277         20
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.25it/s]

                   all        229        639      0.554      0.564
0.572      0.339



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     65/100      9.13G      1.266      1.327      1.272         46
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.32it/s]

                   all        229        639      0.615      0.596
0.611      0.355



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     66/100      9.13G      1.232      1.275      1.247         34
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.39it/s]

                   all        229        639      0.634      0.575
0.604      0.347



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     67/100      9.13G      1.272      1.272      1.265         50
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.37it/s]

                   all        229        639      0.571      0.647
0.629      0.363



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     68/100      9.12G      1.262      1.287      1.265         47
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.33it/s]

                   all        229        639      0.636       0.59
0.613      0.348



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     69/100      9.12G       1.23      1.253      1.247         49
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.40it/s]

                   all        229        639      0.642      0.549
0.628      0.352
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     70/100      9.13G      1.234      1.239       1.25         28
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.25it/s]

                   all        229        639      0.578      0.657
0.63      0.371



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     71/100      9.13G      1.225      1.225      1.233         40
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639      0.548      0.656
0.615      0.358



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     72/100      9.13G      1.233      1.232      1.251         43
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.42it/s]

                   all        229        639      0.589      0.645
0.631      0.365



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     73/100      9.12G      1.207      1.219      1.227         45
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639      0.542      0.641
0.622      0.359
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     74/100      9.13G      1.221      1.205      1.236         80
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.34it/s]

                   all        229        639      0.624      0.626
0.625      0.354



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     75/100      9.12G      1.228       1.21      1.254         44
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.40it/s]

                   all        229        639      0.575      0.625
0.616      0.364



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     76/100      9.13G      1.206      1.207      1.232         28
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.40it/s]

                   all        229        639      0.617      0.623
0.619      0.362



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     77/100      9.12G      1.186      1.162      1.222         24
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.30it/s]
```

```
                   all        229        639       0.57      0.641
0.632      0.367



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     78/100      9.12G      1.216      1.219      1.235         27
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.40it/s]

                   all        229        639      0.658      0.624
0.651      0.369



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     79/100      9.12G      1.177      1.169      1.219         36
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639      0.618      0.644
0.632      0.367



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     80/100      9.12G      1.186      1.153      1.209         35
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.27it/s]

                   all        229        639      0.652       0.62
0.644      0.376



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     81/100      9.13G      1.201      1.138      1.221         39
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.25it/s]

                   all        229        639      0.638      0.622
0.663      0.392



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     82/100      9.12G      1.184      1.136        1.2         26
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.21it/s]

                   all        229        639      0.639      0.653
0.655      0.391



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     83/100      9.13G      1.168      1.142      1.216         34
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.43it/s]

                   all        229        639       0.67      0.612
0.652      0.386



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     84/100      9.12G      1.178      1.103      1.205         33
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

                   all        229        639      0.681      0.601
0.666       0.38



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     85/100      9.13G      1.196       1.12      1.215         22
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.42it/s]

                   all        229        639      0.667      0.632
0.657      0.382



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     86/100      9.12G      1.167      1.069      1.188         37
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]

                   all        229        639      0.622      0.639
0.65      0.376



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     87/100      9.12G      1.152      1.086       1.19         64
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.39it/s]

                   all        229        639      0.681      0.672
0.692      0.409



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     88/100      9.12G      1.182      1.097      1.205         55
640: 100%|██████████| 36/36 [00:22<00:00,  1.58it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.29it/s]

                   all        229        639      0.692      0.614
0.671      0.392
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     89/100      9.12G      1.164      1.071      1.196         40
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.23it/s]

                   all        229        639      0.609      0.682
0.677      0.402



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     90/100      9.13G      1.155      1.071      1.186         63
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.41it/s]

                   all        229        639      0.652      0.654
0.671      0.394


Closing dataloader mosaic
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average',
num_output_channels=3), 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      9.12G      1.069     0.9633      1.197         16
640: 100%|██████████| 36/36 [00:23<00:00,  1.53it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]

                   all        229        639      0.663      0.652
0.68      0.407



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     92/100      9.12G      1.051     0.8806      1.179          9
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.33it/s]

                   all        229        639      0.678      0.647
0.678      0.402



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     93/100      9.12G      1.042     0.8646      1.165         16
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.42it/s]

                   all        229        639      0.708      0.658
0.69       0.41



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     94/100      9.13G      1.047     0.8628      1.172         19
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.17it/s]

                   all        229        639      0.676      0.632
0.675      0.391



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     95/100      9.13G      1.049     0.8781      1.178         11
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.41it/s]

                   all        229        639      0.631      0.663
0.672      0.402



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     96/100      9.13G      1.049     0.8567      1.173         21
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.42it/s]

                   all        229        639      0.672       0.65
0.66      0.388



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     97/100      9.13G      1.038     0.8272      1.168         18
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.33it/s]

                   all        229        639      0.669      0.635
0.681      0.395



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     98/100      9.13G       1.01     0.8187      1.145         15
640: 100%|██████████| 36/36 [00:22<00:00,  1.59it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.29it/s]

                   all        229        639      0.629      0.668
0.665      0.391



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     99/100      9.12G      1.012     0.8194      1.149          8
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.32it/s]

                   all        229        639      0.688       0.64
0.677      0.387
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

    100/100      9.12G      1.031     0.8103      1.144          6
640: 100%|██████████| 36/36 [00:22<00:00,  1.60it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:01<00:00,  2.43it/s]

                   all        229        639      0.698      0.615
0.682      0.389



100 epochs completed in 0.714 hours.
Optimizer stripped from runs/detect/yolov8s_drone/weights/last.pt,
22.5MB
Optimizer stripped from runs/detect/yolov8s_drone/weights/best.pt,
22.5MB

Validating runs/detect/yolov8s_drone/weights/best.pt...
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)
Model summary (fused): 72 layers, 11,128,293 parameters, 0 gradients,
28.5 GFLOPs

                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 4/4 [00:02<00:00,  1.44it/s]

                   all        229        639      0.708      0.659
0.69       0.41
              Artilary         28         45      0.851      0.507
0.662      0.317
    M. Rocket Launcher         29         36      0.589       0.75
0.671      0.503
                Missile         49         92       0.72      0.696
0.719      0.468
                  Radar         27         30      0.558      0.533
0.521      0.239
                Soldier         50        160      0.809      0.619
0.704      0.354
                   Tank         47        118      0.769      0.763
0.813      0.501
                Vehicle         69        158      0.662      0.743
0.739      0.489

/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1
/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
```

```
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1

Speed: 0.1ms preprocess, 4.4ms inference, 0.0ms loss, 1.7ms
postprocess per image
Results saved to runs/detect/yolov8s_drone
```

YOLOv12

```
RUN12 = "yolov12s_drone"


model12 = None
err = None
for candidate in ["yolov12s.pt", "yolo12s.pt"]:
    try:
        model12 = YOLO(candidate)
        print("Loaded:", candidate)
        break
    except Exception as e:
        err = e
        continue

if model12 is None:
    try:
        model12 = YOLO("yolov12s.yaml")
        print("Loaded config: yolov12s.yaml (training from scratch)")
    except Exception as e2:
        print("Could not load YOLOv12 weights/config automatically.")
        print("Last errors:", err, e2)
        raise RuntimeError(
            "Your Ultralytics build may not include YOLOv12. "
            "Upgrade ultralytics to a version that supports YOLO12 or
provide "
            "local weights/config via OFFLINE_WHEELS_DIR."
        )

res12 = model12.train(
    data=str(DATA_YAML),
    epochs=EPOCHS,
    imgsz=IMGSZ,
    batch=BATCH,
    device=0,
    workers=2,
    project="runs/detect",
    name=RUN12,
    verbose=True,
```

```
    patience=PATIENCE,
    optimizer="AdamW",
    lr0=0.003, lrf=0.12, weight_decay=5e-4, warmup_epochs=3,
cos_lr=True,
    degrees=5.0, translate=0.10, scale=0.9, shear=2.0,
    fliplr=0.5, flipud=0.0,
    mosaic=1.0, mixup=0.10, erasing=0.0, copy_paste=0.0,
    close_mosaic=10,
    amp=True
)

Downloading
https://github.com/ultralytics/assets/releases/download/v8.3.0/yolo12s
.pt to 'yolo12s.pt'...

100%|██████████| 18.1M/18.1M [00:00<00:00, 27.8MB/s]

Loaded: yolo12s.pt
New https://pypi.org/project/ultralytics/8.3.178 available 😃 Update
with 'pip install -U ultralytics'
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)
engine/trainer: task=detect, mode=train, model=yolo12s.pt,
data=/kaggle/working/yolo_data/data.yaml, epochs=100, time=None,
patience=30, batch=-1, imgsz=640, save=True, save_period=-1,
cache=False, device=0, workers=2, project=runs/detect,
name=yolov12s_drone, exist_ok=False, pretrained=True, optimizer=AdamW,
verbose=True, seed=0, deterministic=True, single_cls=False,
rect=False, cos_lr=True, 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=0.003, lrf=0.12, momentum=0.937, weight_decay=0.0005,
warmup_epochs=3, warmup_momentum=0.8, warmup_bias_lr=0.1, 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=5.0, translate=0.1, scale=0.9, shear=2.0,
perspective=0.0, flipud=0.0, fliplr=0.5, bgr=0.0, mosaic=1.0,
mixup=0.1, copy_paste=0.0, copy_paste_mode=flip,
auto_augment=randaugment, erasing=0.0, crop_fraction=1.0, cfg=None,
tracker=botsort.yaml, save_dir=runs/detect/yolov12s_drone
Overriding model.yaml nc=80 with nc=7

                   from  n    params  module
```

```
arguments
  0                  -1  1       928  ultralytics.nn.modules.conv.Conv
[3, 32, 3, 2]
  1                  -1  1     18560  ultralytics.nn.modules.conv.Conv
[32, 64, 3, 2]
  2                  -1  1     26080
ultralytics.nn.modules.block.C3k2            [64, 128, 1, False, 0.25]

  3                  -1  1    147712  ultralytics.nn.modules.conv.Conv
[128, 128, 3, 2]
  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    689408
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   2689536
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    822117
ultralytics.nn.modules.head.Detect           [7, [128, 256, 512]]

YOLOv12s summary: 272 layers, 9,255,845 parameters, 9,255,829
gradients, 21.5 GFLOPs

Transferred 685/691 items from pretrained weights
TensorBoard: Start with 'tensorboard --logdir
runs/detect/yolov12s_drone', view at http://localhost:6006/
Freezing layer 'model.21.dfl.conv.weight'
AMP: running Automatic Mixed Precision (AMP) checks...
AMP: checks passed 

train: Scanning /kaggle/working/yolo_data/labels/train.cache... 1301
images, 0 backgrounds, 0 corrupt: 100%|██████████| 1301/1301 [00:00<?,
?it/s]

albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average',
num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0),
tile_grid_size=(8, 8))
AutoBatch: Computing optimal batch size for imgsz=640 at 60.0% CUDA
memory utilization.
AutoBatch: CUDA:0 (Tesla P100-PCIE-16GB) 15.89G total, 0.54G reserved,
0.27G allocated, 15.07G free
      Params      GFLOPs  GPU_mem (GB)  forward (ms) backward (ms)
input                 output



     9255845       21.53         1.426         55.52         241.7
(1, 3, 640, 640)                   list
     9255845       43.07         1.896         47.56         242.4
(2, 3, 640, 640)                   list
     9255845       86.14         2.831         49.66         273.2
(4, 3, 640, 640)                   list
     9255845       172.3         4.473         72.71         345.4
(8, 3, 640, 640)                   list
     9255845       344.6         8.089         137.6         483.5
(16, 3, 640, 640)                   list
AutoBatch: Using batch-size 22 for CUDA:0 9.75G/15.89G (61%) 
```

```
train: Scanning /kaggle/working/yolo_data/labels/train.cache... 1301
images, 0 backgrounds, 0 corrupt: 100%|██████████| 1301/1301 [00:00<?,
?it/s]

albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average',
num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0),
tile_grid_size=(8, 8))


val: Scanning /kaggle/working/yolo_data/labels/val.cache... 229
images, 0 backgrounds, 0 corrupt: 100%|██████████| 229/229 [00:00<?, ?
it/s]

Plotting labels to runs/detect/yolov12s_drone/labels.jpg...
optimizer: AdamW(lr=0.003, momentum=0.937) with parameter groups 113
weight(decay=0.0), 120 weight(decay=0.000515625), 119 bias(decay=0.0)
TensorBoard: model graph visualization added 
Image sizes 640 train, 640 val
Using 2 dataloader workers
Logging results to runs/detect/yolov12s_drone
Starting training for 100 epochs...

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      1/100      8.88G      1.849      3.359      1.742         25
640: 100%|██████████| 60/60 [00:49<00:00,  1.21it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95):   0%|          | 0/6 [00:00<?,
?it/s]/usr/local/lib/python3.11/dist-packages/ultralytics/engine/valid
ator.py:255: RuntimeWarning: invalid value encountered in
greater_equal
  matches = np.nonzero(iou >= threshold)  # IoU > threshold and
classes match
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:04<00:00,  1.43it/s]

                   all        229        639    0.00683     0.0166
0.00113   0.000382

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      2/100      8.75G      1.972      2.925      1.888         19
640: 100%|██████████| 60/60 [00:48<00:00,  1.23it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.42it/s]

                   all        229        639     0.0196      0.162
0.00706    0.00266
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      3/100      8.71G      2.022      2.949      1.923         19
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.62it/s]

                   all        229        639     0.0454      0.099
0.0204    0.00894



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      4/100      8.61G      1.967      2.922      1.881          9
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.27it/s]

                   all        229        639     0.0931      0.151
0.0533     0.0207



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      5/100      8.69G      1.945      2.789      1.836         15
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.58it/s]

                   all        229        639      0.262      0.225
0.114     0.0431



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

      6/100       8.6G      1.861      2.729      1.819          7
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.39it/s]
```

```
                   all        229        639      0.303      0.134
0.0879     0.0393

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
      7/100      8.69G      1.788      2.648      1.753         12
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.61it/s]

                   all        229        639      0.449      0.156
0.135     0.0637

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
      8/100      8.72G      1.808      2.602      1.755         28
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.62it/s]

                   all        229        639      0.288      0.217
0.137     0.0646

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
      9/100      8.72G      1.785      2.564      1.745         13
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.64it/s]

                   all        229        639      0.304      0.201
0.165     0.0751

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
     10/100      8.67G      1.771      2.528      1.718          6
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.65it/s]

                   all        229        639      0.223      0.247
0.19     0.0895



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     11/100      8.72G      1.739        2.5      1.706         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.67it/s]

                   all        229        639      0.218      0.278
0.173     0.0773



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     12/100      8.71G      1.756      2.444      1.675         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.60it/s]

                   all        229        639      0.127      0.297
0.139     0.0553



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     13/100      8.76G      1.751      2.434      1.699         10
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.68it/s]

                   all        229        639      0.214      0.265
0.187     0.0831



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     14/100       8.7G      1.719      2.434      1.689         19
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.55it/s]

                   all        229        639      0.365      0.266
0.2     0.0948



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     15/100      8.76G      1.708      2.412      1.683         22
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.67it/s]

                   all        229        639      0.191      0.272
0.174     0.0859



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     16/100      8.56G      1.663      2.388      1.629         14
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.65it/s]

                   all        229        639      0.226      0.311
0.201     0.0956



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     17/100      8.84G      1.686      2.323      1.643         34
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.63it/s]

                   all        229        639      0.278      0.288
0.224       0.11
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     18/100      8.56G      1.686      2.325      1.652         41
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.68it/s]

                   all        229        639      0.377      0.295
0.263      0.134



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     19/100       8.7G      1.652      2.233      1.615         10
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.70it/s]

                   all        229        639      0.253      0.343
0.231      0.109



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     20/100      8.71G      1.662      2.291      1.642         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.63it/s]

                   all        229        639        0.2      0.327
0.215      0.106



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     21/100      8.84G      1.663      2.252      1.632         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.60it/s]

                   all        229        639      0.346      0.341
0.235       0.12
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     22/100      8.71G      1.624      2.232      1.601         15
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.68it/s]

                   all        229        639      0.272      0.347
0.246       0.13



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     23/100       8.8G      1.612      2.209      1.587         11
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.69it/s]

                   all        229        639      0.285      0.348
0.242      0.122



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     24/100      8.73G      1.604      2.142      1.579         14
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.73it/s]

                   all        229        639      0.258      0.391
0.288      0.153



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     25/100      8.73G      1.602      2.163       1.56         12
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.69it/s]
```

```
                   all        229        639       0.27       0.39
0.315      0.171



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     26/100      8.72G      1.575      2.138      1.556         48
640: 100%|██████████| 60/60 [00:48<00:00,  1.23it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.71it/s]

                   all        229        639      0.325      0.389
0.288      0.159



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     27/100      8.85G       1.56      2.091      1.553         15
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.74it/s]

                   all        229        639      0.315      0.307
0.261      0.132



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     28/100      8.71G      1.609      2.124      1.573         11
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.68it/s]

                   all        229        639      0.297      0.422
0.307      0.157



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     29/100      8.71G      1.577      2.108      1.556         16
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639      0.318      0.372
0.324       0.17



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     30/100      8.72G      1.559      2.059      1.563         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.65it/s]

                   all        229        639      0.287       0.43
0.325       0.17



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     31/100      8.67G      1.549      2.043      1.528         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.69it/s]

                   all        229        639      0.344      0.397
0.308      0.151



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     32/100      8.67G      1.527      1.985      1.534         17
640: 100%|██████████| 60/60 [00:48<00:00,  1.23it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.71it/s]

                   all        229        639      0.585      0.311
0.357       0.18



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     33/100      8.67G      1.523      2.006      1.531          4
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.65it/s]

                   all        229        639      0.325      0.419
0.332      0.182



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     34/100      8.71G      1.507      1.966      1.534         35
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.76it/s]

                   all        229        639       0.35      0.383
0.337      0.184



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     35/100      8.68G       1.55      1.981      1.517         21
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.79it/s]

                   all        229        639      0.419      0.409
0.367      0.184



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     36/100      8.68G       1.55       1.97      1.545         17
640: 100%|██████████| 60/60 [00:48<00:00,  1.23it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639      0.396      0.453
0.377      0.203
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     37/100      8.71G      1.531      1.988      1.524         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.66it/s]

                   all        229        639      0.412      0.437
0.381      0.201



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     38/100      8.67G      1.536      1.947      1.516         23
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.76it/s]

                   all        229        639      0.419      0.402
0.368      0.187



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     39/100       8.6G      1.533      1.947      1.515         44
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.68it/s]

                   all        229        639      0.297      0.425
0.336      0.189



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     40/100      8.68G      1.487      1.903       1.49          9
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639      0.432       0.41
0.375      0.204
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     41/100      8.67G      1.485      1.875      1.483         19
640: 100%|██████████| 60/60 [00:48<00:00,  1.23it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.69it/s]

                   all        229        639      0.428      0.411
0.394      0.202



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     42/100      8.68G      1.485      1.884      1.492         15
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.68it/s]

                   all        229        639       0.42      0.425
0.414       0.22



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     43/100      8.69G      1.483      1.852      1.484         26
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.67it/s]

                   all        229        639      0.362      0.456
0.416      0.235



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     44/100      8.58G      1.485      1.833      1.466         19
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]
```

```
                   all        229        639       0.41      0.462
0.413      0.234



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     45/100       8.7G      1.456      1.816      1.464         14
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.68it/s]

                   all        229        639      0.422      0.445
0.385      0.213



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     46/100      8.69G      1.457      1.812      1.475         12
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.78it/s]

                   all        229        639      0.423      0.439
0.422      0.227



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     47/100      8.68G      1.458      1.782      1.471          7
640: 100%|██████████| 60/60 [00:48<00:00,  1.23it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.74it/s]

                   all        229        639      0.425      0.477
0.424      0.242



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     48/100      8.84G      1.472      1.809      1.472         17
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]
                   all        229        639      0.405      0.448
0.426      0.224



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
     49/100       8.7G      1.441      1.767      1.446          9
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.62it/s]
                   all        229        639       0.47      0.378
0.416      0.238



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
     50/100      8.58G      1.425      1.742      1.449         11
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.73it/s]
                   all        229        639      0.486      0.452
0.45      0.256



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
     51/100       8.7G      1.431      1.744      1.432         29
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.74it/s]
                   all        229        639      0.469       0.46
0.468      0.251



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     52/100      8.69G      1.441      1.737      1.449         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639      0.432      0.463
0.443      0.243



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     53/100      8.72G      1.437      1.723      1.442         26
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639      0.538      0.467
0.451      0.246



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     54/100       8.7G       1.42      1.696      1.441         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.70it/s]

                   all        229        639      0.479      0.505
0.475      0.266



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     55/100      8.69G      1.401      1.691      1.419         28
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.70it/s]

                   all        229        639      0.467      0.494
0.463      0.249
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     56/100      8.72G      1.392      1.697      1.412         13
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.73it/s]

                   all        229        639      0.525      0.417
0.451      0.257



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     57/100      8.84G      1.419      1.736      1.435          3
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639      0.426      0.468
0.428      0.241



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     58/100      8.58G      1.384      1.655      1.419         22
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.76it/s]

                   all        229        639       0.48      0.462
0.47      0.265



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     59/100      8.71G      1.391      1.651      1.411         28
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.70it/s]

                   all        229        639      0.466      0.491
0.492       0.28
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     60/100      8.72G       1.39       1.65      1.401         17
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639      0.484      0.516
0.503      0.294



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     61/100      8.68G      1.382      1.628      1.405         25
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.75it/s]

                   all        229        639      0.418      0.549
0.477      0.272



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     62/100       8.6G      1.383      1.605      1.404         23
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.71it/s]

                   all        229        639      0.409      0.484
0.45      0.264



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     63/100      8.59G      1.378      1.577      1.395         26
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.74it/s]
```

```
                   all        229        639      0.495      0.497
0.489      0.283



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     64/100      8.68G       1.35      1.554      1.374         15
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.71it/s]

                   all        229        639      0.571      0.517
0.521        0.3



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     65/100      8.71G      1.358      1.597      1.395         15
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.70it/s]

                   all        229        639      0.524      0.512
0.522        0.3



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     66/100      8.69G      1.371      1.567      1.376         28
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.77it/s]

                   all        229        639      0.442       0.51
0.502      0.296



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     67/100      8.68G      1.355      1.565      1.381         11
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.78it/s]

                   all        229        639      0.502      0.503
0.487      0.283



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     68/100      8.58G      1.363      1.522      1.382         21
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.74it/s]

                   all        229        639      0.573        0.5
0.527        0.3



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     69/100      8.69G      1.381      1.578      1.398         25
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.71it/s]

                   all        229        639      0.526      0.525
0.52      0.295



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     70/100      8.72G      1.338      1.541      1.372         37
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.71it/s]

                   all        229        639      0.476      0.535
0.515      0.299



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     71/100      8.68G      1.323       1.51      1.362          18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.71it/s]

                   all        229        639      0.564      0.521
0.543      0.307



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     72/100      8.69G       1.34      1.544       1.38          19
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.76it/s]

                   all        229        639      0.553      0.522
0.555      0.322



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     73/100      8.68G      1.322      1.482      1.359          19
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.67it/s]

                   all        229        639      0.516      0.543
0.53      0.297



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     74/100      8.69G      1.337      1.512      1.378           7
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.72it/s]

                   all        229        639       0.53      0.575
0.537      0.307
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     75/100      8.68G      1.336      1.505      1.374         23
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.77it/s]

                   all        229        639      0.594      0.564
0.572      0.327



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     76/100      8.68G      1.309      1.498       1.36          5
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.75it/s]

                   all        229        639      0.573      0.525
0.554      0.323



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     77/100      8.68G      1.309      1.501      1.356         15
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.78it/s]

                   all        229        639      0.513      0.549
0.542      0.313



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     78/100      8.58G      1.322      1.473      1.355         18
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.79it/s]

                   all        229        639      0.537      0.594
0.557      0.329
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     79/100      8.68G      1.322      1.477       1.37         20
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.77it/s]

                   all        229        639      0.461      0.595
0.522      0.308



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     80/100      8.68G      1.296      1.409      1.336         19
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.76it/s]

                   all        229        639      0.531      0.586
0.552      0.319



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     81/100      8.72G      1.299      1.431      1.363         10
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.74it/s]

                   all        229        639      0.568      0.539
0.579      0.337



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     82/100      8.72G      1.319      1.426       1.36         10
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.77it/s]
```

```
                   all        229        639      0.491      0.593
0.557      0.334



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     83/100      8.67G      1.305      1.415      1.334         20
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.76it/s]

                   all        229        639      0.541      0.603
0.597      0.352



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     84/100      8.59G      1.281      1.362      1.317         13
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.67it/s]

                   all        229        639      0.614      0.563
0.592      0.337



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     85/100      8.57G      1.283      1.379      1.323         19
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.76it/s]

                   all        229        639      0.599      0.571
0.586      0.345



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     86/100      8.68G      1.274      1.375      1.317         11
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.78it/s]

                   all        229        639      0.605      0.561
0.586      0.337



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     87/100      8.72G      1.305      1.408      1.331         12
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.80it/s]

                   all        229        639      0.565       0.56
0.587      0.351



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     88/100      8.68G      1.283      1.386      1.326          9
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.78it/s]

                   all        229        639      0.583      0.544
0.574      0.336



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     89/100      8.68G      1.281      1.372       1.32         20
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.75it/s]

                   all        229        639      0.578      0.588
0.591      0.344



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size
```

```
     90/100      8.72G      1.264      1.354      1.329         14
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.75it/s]

                   all        229        639      0.542      0.608
0.59      0.343


Closing dataloader mosaic
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average',
num_output_channels=3), 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      8.68G      1.177      1.251      1.335         11
640: 100%|██████████| 60/60 [00:48<00:00,  1.23it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.73it/s]

                   all        229        639      0.606       0.57
0.593      0.337



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     92/100      8.69G      1.188      1.223      1.341          9
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.78it/s]

                   all        229        639      0.582      0.602
0.602      0.358



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     93/100      8.69G      1.189      1.177       1.32          8
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.80it/s]
```

```
                   all        229        639      0.609      0.576
0.594      0.343



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     94/100       8.6G      1.181      1.155       1.31          6
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.81it/s]

                   all        229        639      0.585      0.602
0.613      0.349



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     95/100      8.69G       1.17      1.139      1.313          3
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.81it/s]

                   all        229        639       0.57       0.63
0.608      0.354



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     96/100      8.68G      1.133      1.113      1.299          4
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.82it/s]

                   all        229        639      0.622       0.57
0.606      0.366



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     97/100      8.68G       1.16      1.095       1.31         10
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
```

```
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.80it/s]

                   all        229        639        0.6        0.6
0.613      0.369



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     98/100      8.69G      1.155      1.107      1.305         11
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.78it/s]

                   all        229        639      0.559      0.617
0.611      0.363



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

     99/100      8.69G       1.16      1.141      1.304          3
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.80it/s]

                   all        229        639      0.599      0.602
0.611      0.365



      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances
Size

    100/100       8.6G      1.151      1.089        1.3          3
640: 100%|██████████| 60/60 [00:48<00:00,  1.24it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:02<00:00,  2.80it/s]

                   all        229        639      0.636       0.58
0.637      0.363



100 epochs completed in 1.449 hours.
Optimizer stripped from runs/detect/yolov12s_drone/weights/last.pt,
```

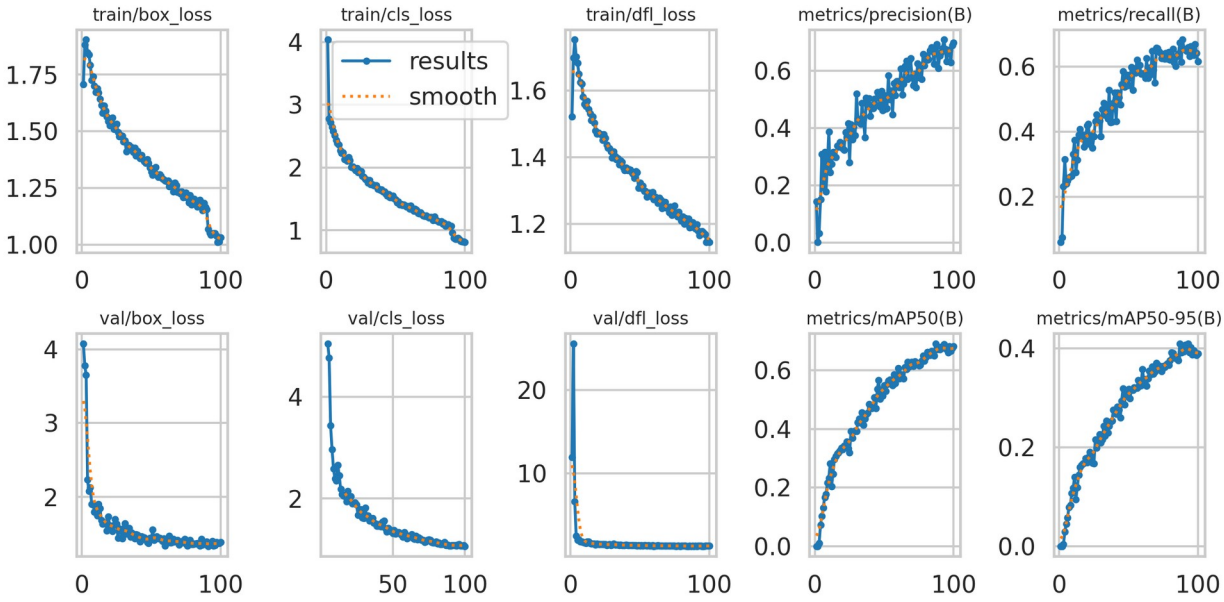
```
18.9MB
Optimizer stripped from runs/detect/yolov12s_drone/weights/best.pt,
18.9MB

Validating runs/detect/yolov12s_drone/weights/best.pt...
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)
YOLOv12s summary (fused): 159 layers, 9,233,589 parameters, 0
gradients, 21.2 GFLOPs

                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 6/6 [00:03<00:00,  1.97it/s]

                   all        229        639      0.601      0.601
0.613      0.369
              Artilary         28         45      0.666      0.532
0.581      0.296
    M. Rocket Launcher         29         36       0.47      0.518
0.517      0.391
               Missile         49         92      0.646      0.587
0.645      0.429
                 Radar         27         30      0.447        0.5
0.421      0.185
               Soldier         50        160      0.718       0.59
0.675      0.354
                  Tank         47        118      0.615      0.737
0.729      0.441
               Vehicle         69        158      0.647      0.741
0.721      0.486

/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1
/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1

Speed: 0.1ms preprocess, 6.8ms inference, 0.0ms loss, 1.3ms
postprocess per image
Results saved to runs/detect/yolov12s_drone
```

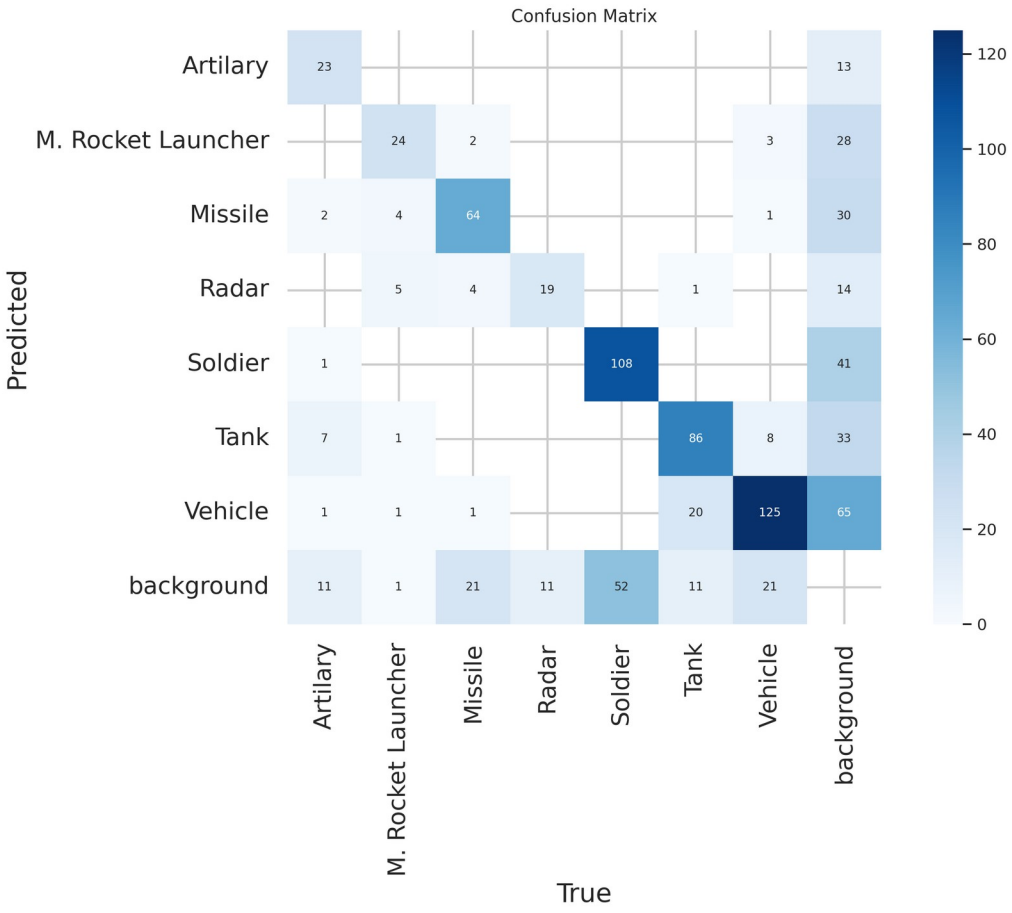
Plot of results

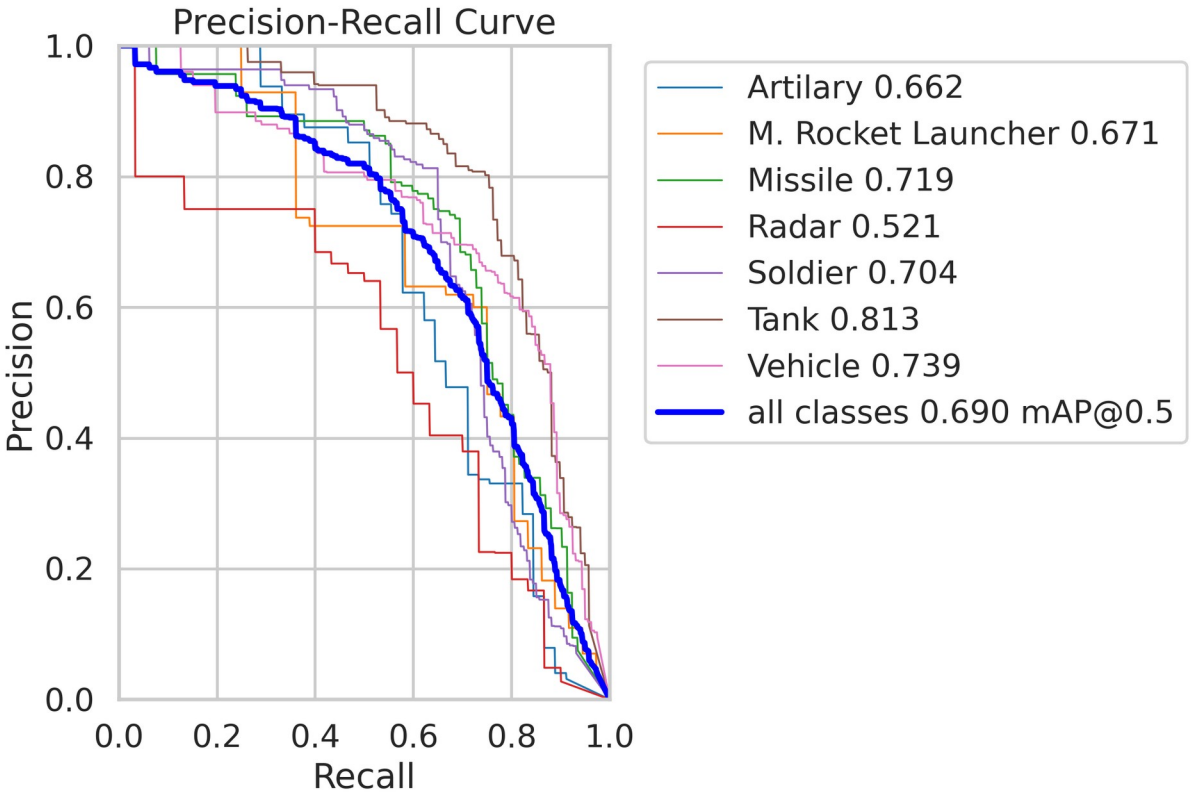
```
from IPython.display import Image, display
def show_run(run_name: str):
    rd = Path("runs/detect") / run_name
    print("Run dir:", rd)
    for f in ["results.png","confusion_matrix.png","PR_curve.png",
```

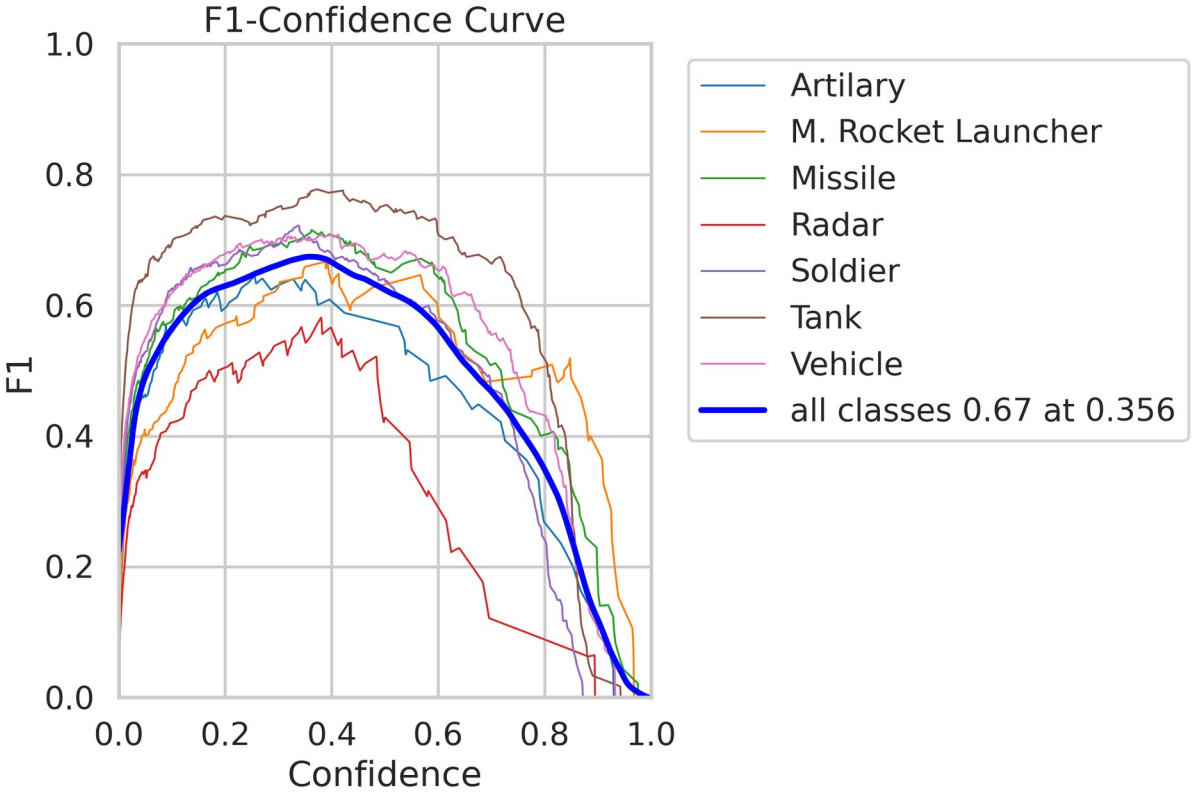
```
                "F1_curve.png","P_curve.png","R_curve.png"]:
        p = rd / f
        if p.exists():
            display(Image(filename=str(p)))

show_run(RUN8)
show_run(RUN12)
```

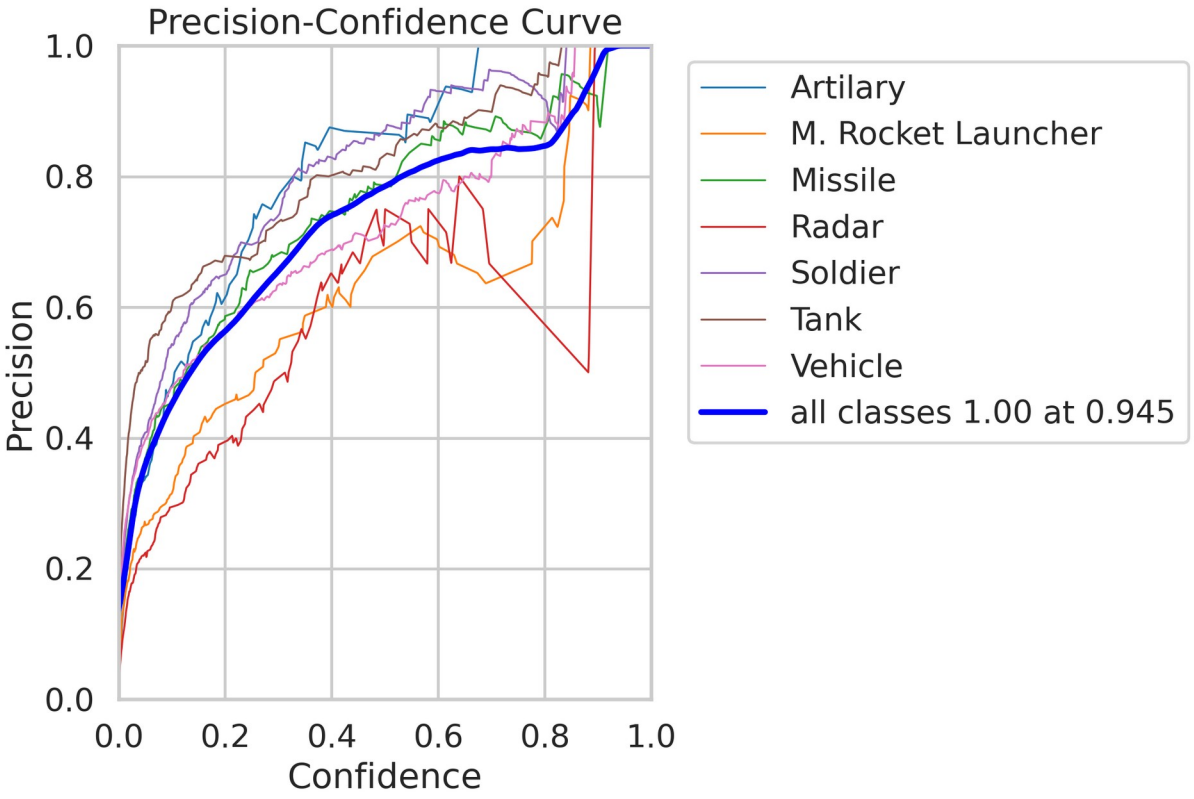
```
Run dir: runs/detect/yolov8s_drone
```

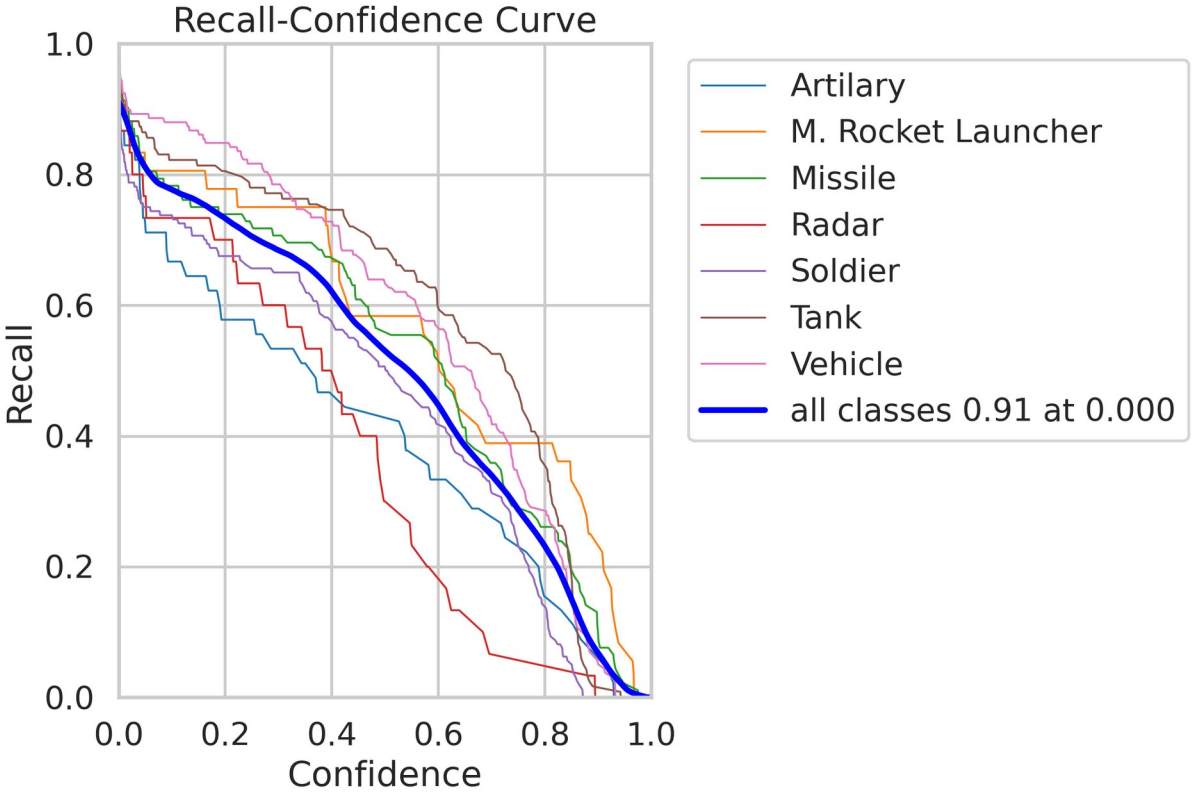



Confusion Matrix
Predicted
True
Artilary
M. Rocket Launcher
Missile
Radar
Soldier
Tank
Vehicle
background
23 13
24 2 3 28
2 4 64 1 30
5 4 19 1 14
1 108 41
7 1 86 8 33
1 1 1 20 125 65
11 1 21 11 52 11 21
120
100
80
60
40
20
0

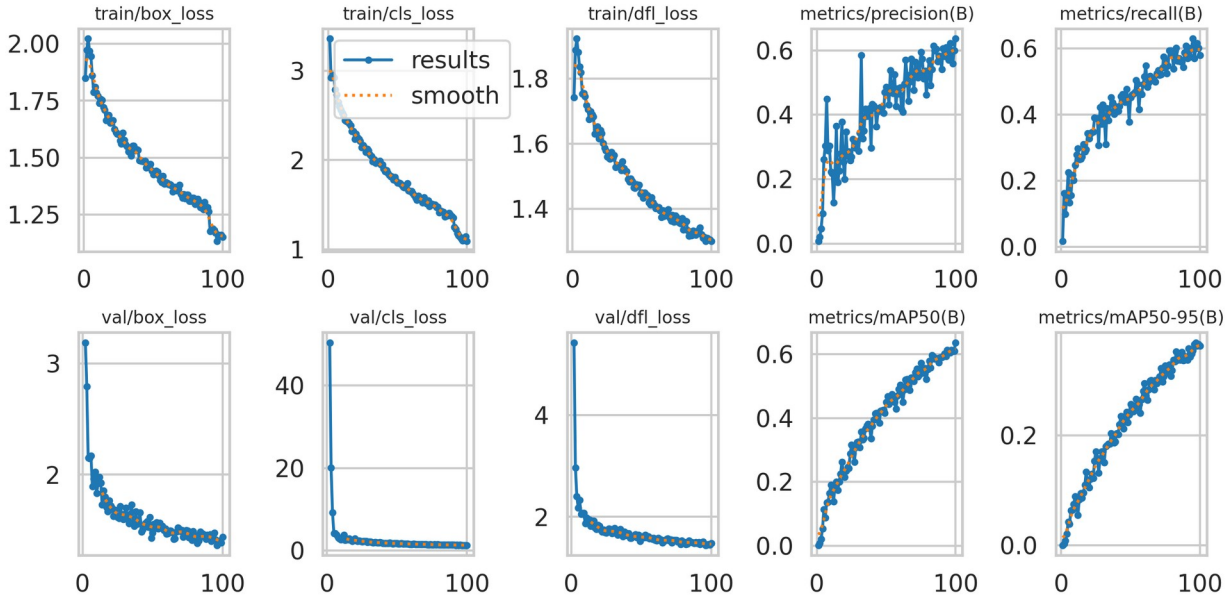

Precision-Recall Curve
Precision
Recall
0.0
0.2
0.4
0.6
0.8
1.0
Artilary 0.662
M. Rocket Launcher 0.671
Missile 0.719
Radar 0.521
Soldier 0.704
Tank 0.813
Vehicle 0.739
all classes 0.690 mAP@0.5

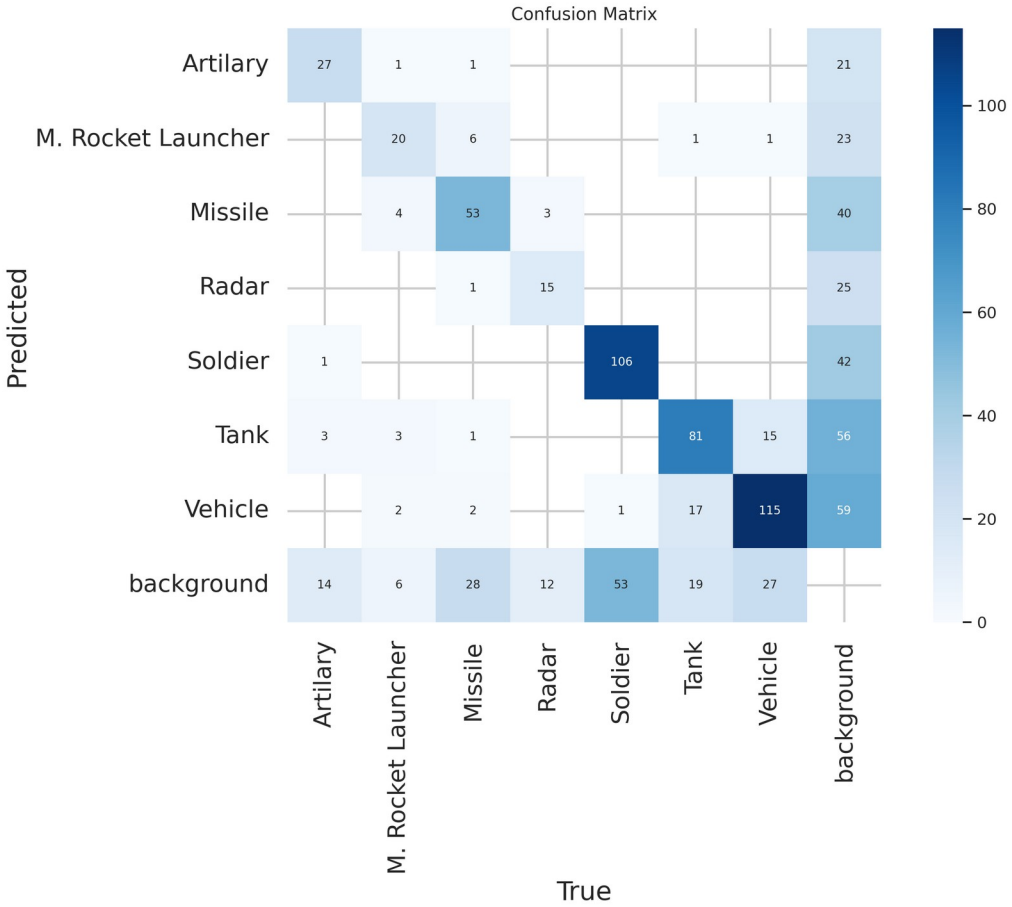

F1-Confidence Curve
F1
Confidence
0.0
0.2
0.4
0.6
0.8
1.0
Artilary
M. Rocket Launcher
Missile
Radar
Soldier
Tank
Vehicle
all classes 0.67 at 0.356

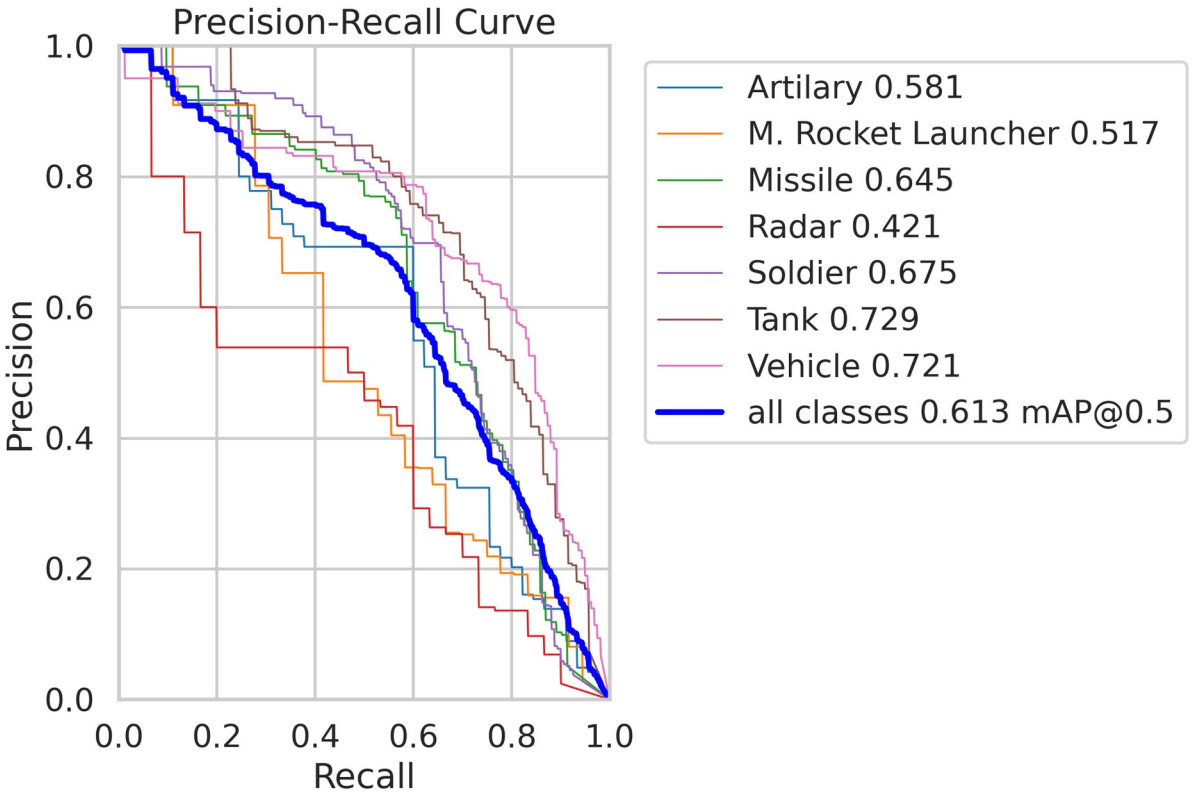

Precision-Confidence Curve
Precision
Confidence
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Artilary
M. Rocket Launcher
Missile
Radar
Soldier
Tank
Vehicle
all classes 1.00 at 0.945

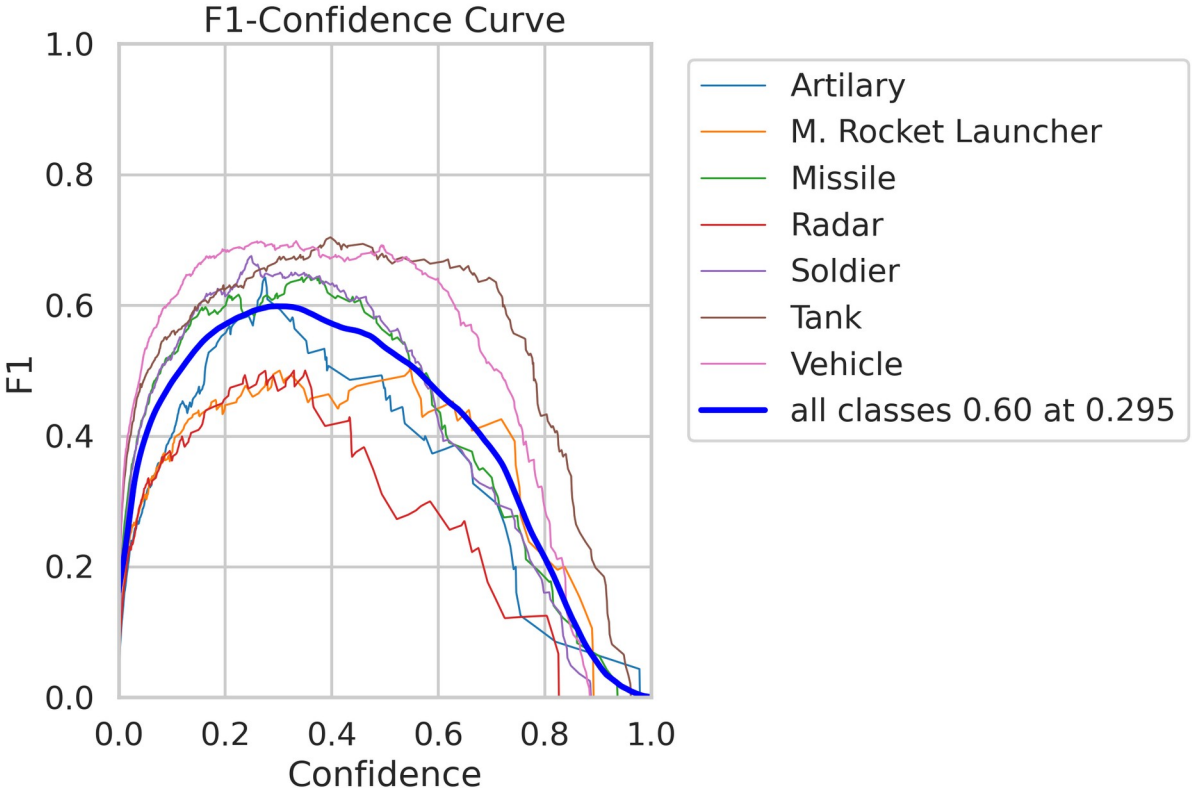

Recall-Confidence Curve
Recall
Confidence
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Artilary
M. Rocket Launcher
Missile
Radar
Soldier
Tank
Vehicle
all classes 0.91 at 0.000

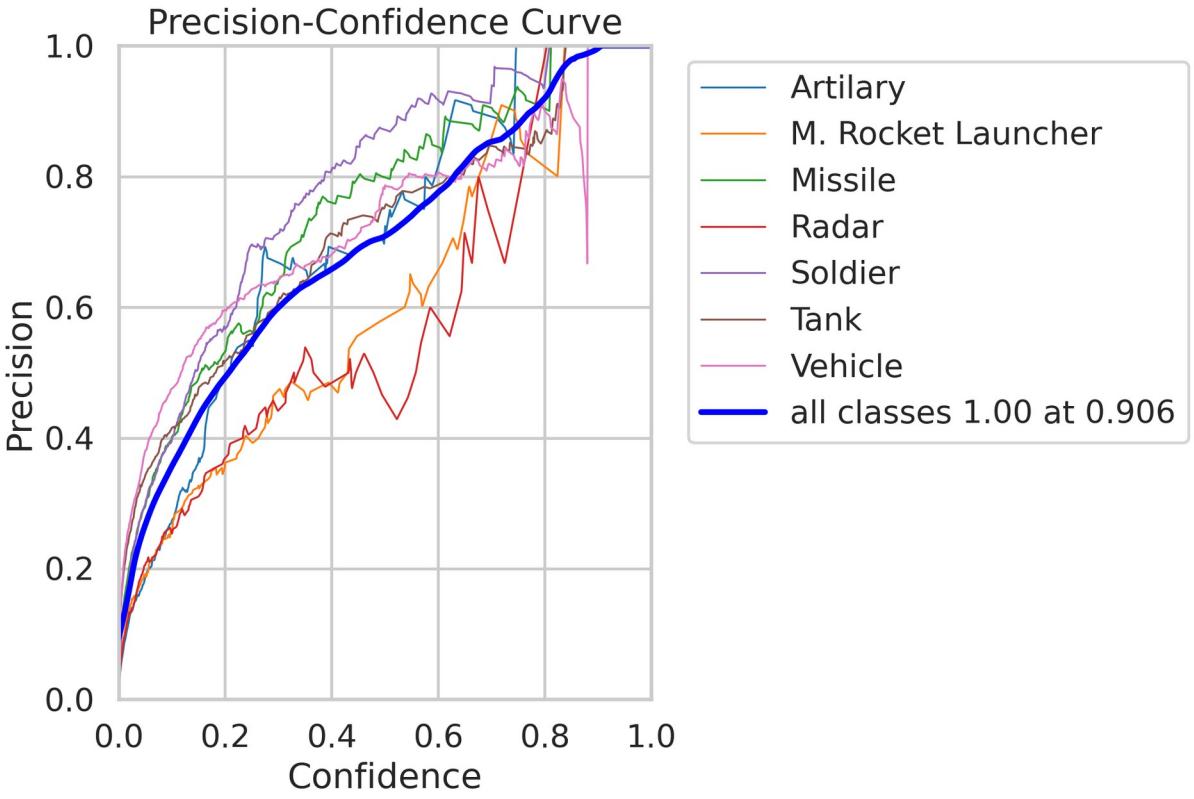
```
Run dir: runs/detect/yolov12s_drone
```

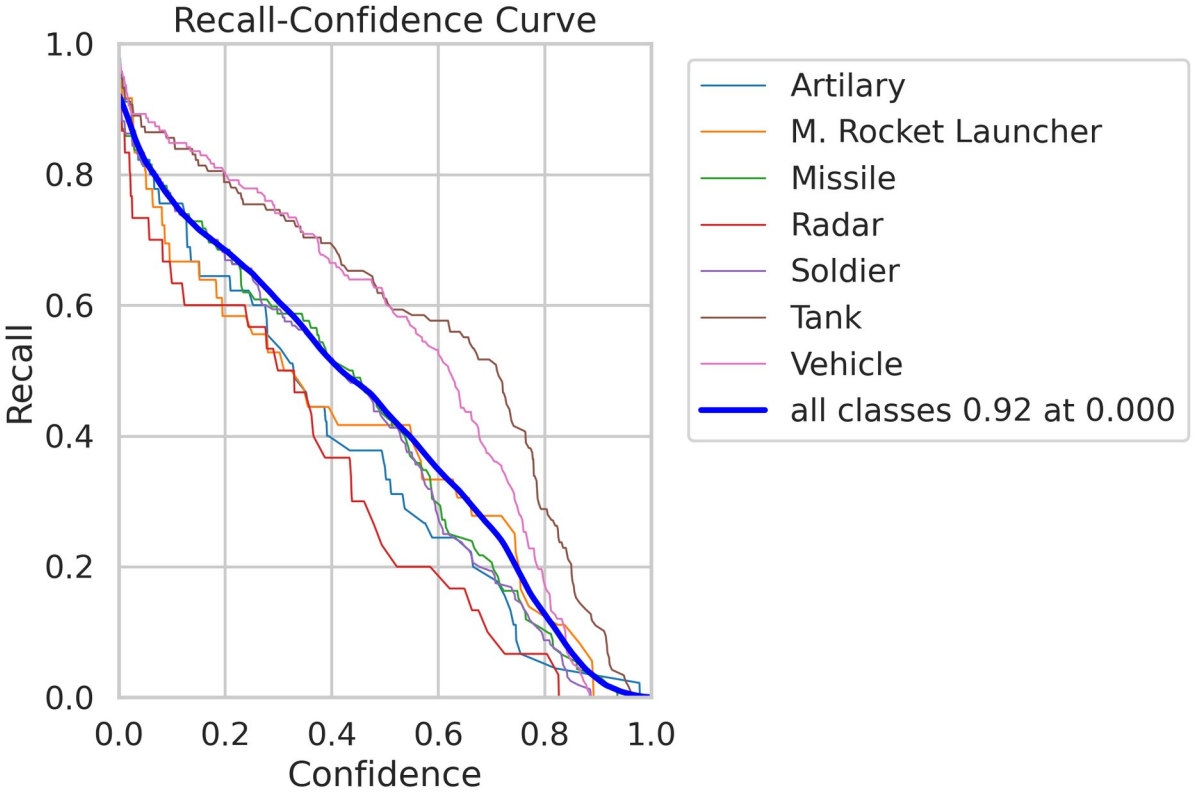





Precision-Recall Curve
Precision
Recall
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Artilary 0.581
M. Rocket Launcher 0.517
Missile 0.645
Radar 0.421
Soldier 0.675
Tank 0.729
Vehicle 0.721
all classes 0.613 mAP@0.5


F1-Confidence Curve
F1
Confidence
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Artilary
M. Rocket Launcher
Missile
Radar
Soldier
Tank
Vehicle
all classes 0.60 at 0.295


Precision-Confidence Curve
Precision
Confidence
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Artilary
M. Rocket Launcher
Missile
Radar
Soldier
Tank
Vehicle
all classes 1.00 at 0.906


Recall-Confidence Curve
Recall
Confidence
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Artilary
M. Rocket Launcher
Missile
Radar
Soldier
Tank
Vehicle
all classes 0.92 at 0.000

```
best8  = YOLO(str(Path("runs/detect") / RUN8  / "weights" /
"best.pt"))
best12 = YOLO(str(Path("runs/detect") / RUN12 / "weights" /
"best.pt"))

print("YOLOv8 Validation:")
m8 = best8.val(data=str(DATA_YAML), imgsz=IMGSZ, device=0, plots=True)

print("YOLOv12 Validation:")
m12 = best12.val(data=str(DATA_YAML), imgsz=IMGSZ, device=0,
plots=True)


test_lbl_dir = YOLO_DATA / "labels/test"
if test_lbl_dir.exists() and any(test_lbl_dir.glob("*.txt")):
    print("\nEvaluating on TEST split (labels found):")
    data_test_yaml = YOLO_DATA / "data_test.yaml"
    with open(data_test_yaml, "w") as f:
        yaml.safe_dump({
            "path": str(YOLO_DATA),
            "train": "images/train",
            "val":   "images/val",
            "test":  "images/test",
            "names": classes
        }, f, sort_keys=False)
    _ = best8.val(data=str(data_test_yaml), split="test", imgsz=IMGSZ,
device=0)
    _ = best12.val(data=str(data_test_yaml), split="test",
imgsz=IMGSZ, device=0)
else:
    print("No test labels found; skipping test evaluation (we'll do
predictions next).")
```

```
YOLOv8 Validation:
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)
Model summary (fused): 72 layers, 11,128,293 parameters, 0 gradients,
28.5 GFLOPs

val: Scanning /kaggle/working/yolo_data/labels/val.cache... 229
images, 0 backgrounds, 0 corrupt: 100%|██████████| 229/229 [00:00<?, ?
it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 15/15 [00:03<00:00,  4.68it/s]

                   all        229        639      0.697      0.653
0.685       0.41
               Artilary         28         45      0.819      0.504
0.661      0.326
```

```
    M. Rocket Launcher         29         36      0.574       0.75
0.667      0.493
               Missile         49         92      0.704      0.685
0.716      0.477
                 Radar         27         30      0.555      0.533
0.505      0.238
               Soldier         50        160      0.808      0.606
0.701      0.351
                  Tank         47        118      0.764      0.746
0.805      0.499
               Vehicle         69        158      0.655      0.744
0.741      0.488

/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1
/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1

Speed: 0.9ms preprocess, 5.8ms inference, 0.0ms loss, 2.0ms
postprocess per image
Results saved to runs/detect/val
YOLOv12 Validation:
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)
YOLOv12s summary (fused): 159 layers, 9,233,589 parameters, 0
gradients, 21.2 GFLOPs

val: Scanning /kaggle/working/yolo_data/labels/val.cache... 229
images, 0 backgrounds, 0 corrupt: 100%|██████████| 229/229 [00:00<?, ?
it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 15/15 [00:03<00:00,  4.06it/s]

                   all        229        639      0.598      0.589
0.609      0.369
                Artilary         28         45       0.62      0.507
0.559       0.29
    M. Rocket Launcher         29         36      0.452      0.528
0.518      0.394
               Missile         49         92      0.669      0.587
0.64      0.425
                 Radar         27         30       0.44      0.446
0.41      0.185
               Soldier         50        160       0.74      0.586
0.69      0.355
                  Tank         47        118      0.617      0.729
0.727      0.443
```

```
               Vehicle         69        158      0.647      0.741
0.722      0.487

/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1
/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1

Speed: 1.0ms preprocess, 6.9ms inference, 0.0ms loss, 2.8ms
postprocess per image
Results saved to runs/detect/val2

Evaluating on TEST split (labels found):
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)

val: Scanning /kaggle/working/yolo_data/labels/test... 170 images, 0
backgrounds, 0 corrupt: 100%|██████████| 170/170 [00:00<00:00,
470.29it/s]

val: New cache created: /kaggle/working/yolo_data/labels/test.cache


                  Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 11/11 [00:02<00:00,  4.16it/s]

                    all        170        419      0.629      0.631
0.636      0.405
               Artilary         23         40      0.692      0.505
0.567      0.304
    M. Rocket Launcher         25         45      0.717      0.756
0.778      0.573
                Missile         23         36      0.558      0.611
0.59      0.446
                  Radar         31         34      0.499      0.471
0.379      0.205
                Soldier         36        120      0.625       0.65
0.621      0.306
                   Tank         34         58      0.646      0.691
0.748      0.467
                Vehicle         39         86      0.669      0.733
0.77      0.532

/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1
/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1
```

```
Speed: 1.3ms preprocess, 4.4ms inference, 0.0ms loss, 1.3ms
postprocess per image
Results saved to runs/detect/val3
Ultralytics 8.3.78 □ Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla
P100-PCIE-16GB, 16269MiB)

val: Scanning /kaggle/working/yolo_data/labels/test.cache... 170
images, 0 backgrounds, 0 corrupt: 100%|██████████| 170/170 [00:00<?, ?
it/s]
                 Class     Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 11/11 [00:03<00:00,  3.48it/s]

                   all        170        419      0.587      0.598
0.599      0.369
              Artilary         23         40      0.666      0.499
0.499      0.216
    M. Rocket Launcher         25         45      0.649      0.689
0.754      0.559
               Missile         23         36      0.574        0.5
0.527       0.36
                 Radar         31         34      0.441      0.471
0.38      0.219
               Soldier         36        120      0.532      0.636
0.592      0.285
                  Tank         34         58      0.576      0.741
0.719      0.443
               Vehicle         39         86      0.673      0.651
0.721      0.498

/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1
/usr/local/lib/python3.11/dist-packages/matplotlib/colors.py:721:
RuntimeWarning: invalid value encountered in less
  xa[xa < 0] = -1

Speed: 1.6ms preprocess, 7.4ms inference, 0.0ms loss, 2.3ms
postprocess per image
Results saved to runs/detect/val4
```

Save the models

```
best_model_path =
"/kaggle/working/results_v8/drone_yolov8/weights/best.pt"
print("Best model saved at:", best_model_path)

Best model saved at:
/kaggle/working/results_v8/drone_yolov8/weights/best.pt
```

Thank You.