

# YOLO小目标检测优化方案 (4050 Laptop 显存优化版)

本Notebook用于处理label studio导出的YOLO格式数据，通过缩小图像增强模型对小目标的敏感度。**关键优化**: YOLO标签采用归一化坐标，缩放图像后无需修改标签文件，直接复制即可，大幅节省计算资源。

```
In [49]: # 步骤1: 安装依赖 (仅第一次运行需要)
# !pip install ultralytics==8.2.0 pillow tqdm psutil
```

```
In [50]: # 🚨 必须在任何导入之前执行此单元格
import os
import sys

# 修复OpenMP冲突 (解决libiomp5md.dll重复初始化问题)
os.environ['KMP_DUPLICATE_LIB_OK'] = 'TRUE'
# os.environ['OMP_NUM_THREADS'] = '1' # 限制OpenMP线程数

# 可选: 完全禁用OpenMP (更激进但更安全)
# os.environ['MKL_THREADING_LAYER'] = 'GNU'

print("✅ OpenMP环境变量已设置")
print(f"🔧 KMP_DUPLICATE_LIB_OK = {os.getenv('KMP_DUPLICATE_LIB_OK')}")
print(f"🔧 OMP_NUM_THREADS = {os.getenv('OMP_NUM_THREADS')}")
```

✓ OpenMP环境变量已设置  
🔧 KMP\_DUPLICATE\_LIB\_OK = TRUE  
🔧 OMP\_NUM\_THREADS = 1

```
In [51]: # 步骤2: 导入库
import os
from pathlib import Path
from PIL import Image
import shutil
from tqdm.notebook import tqdm
import yaml
import torch
import psutil
import gc

# 清理GPU缓存
torch.cuda.empty_cache()
```

```
In [52]: # 步骤3: 配置参数 (按需修改)
INPUT_FOLDER = "data/1210-403" # 原始数据集文件夹
SCALE_FACTOR = 4 # 缩小倍数 (默认1/4)
BATCH_SIZE = 16 # 根据RTX 4050 Laptop 6GB显存设置为4最安全
IMAGE_SIZE = 640 # 训练图像尺寸
```

```
In [53]: # 步骤4: 内存监控函数 (用于实时观察资源使用)
def print_memory_usage():
    """打印当前内存和显存使用情况"""
    # GPU显存
    if torch.cuda.is_available():
```

```

    allocated = torch.cuda.memory_allocated() / 1024**3
    reserved = torch.cuda.memory_reserved() / 1024**3
    max_allocated = torch.cuda.max_memory_allocated() / 1024**3
    print(
        f"GPU显存: {allocated:.2f}GB(已用) / {reserved:.2f}GB(保留) / {max_allocated:.2f}GB(峰值)")

# 系统内存
memory = psutil.virtual_memory()
print(
    f"系统内存: {memory.used / 1024**3:.2f}GB(已用) / {memory.total / 1024**3:.2f}GB(总计)")
print("-" * 60)

print_memory_usage()

```

GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)  
 系统内存: 11.43GB(已用) / 15.81GB(总计) / 72.3%

```

In [54]: # 步骤5: 核心函数 - 生成缩小数据集
def create_downsampled_dataset(input_folder: str, scale_factor: int = 4):
    """
    创建缩小版数据集
    - 图像按比例缩小
    - YOLO标签直接复制（归一化坐标无需转换）
    """
    input_path = Path(input_folder)
    if not input_path.exists():
        raise FileNotFoundError(f"输入文件夹不存在: {input_folder}")

    # 创建输出文件夹
    folder_name = input_path.name
    output_path = input_path.parent / f"{folder_name}-det"
    output_images = output_path / "images"
    output_labels = output_path / "labels"

    # 清空旧数据（如果存在）
    if output_path.exists():
        shutil.rmtree(output_path)

    output_images.mkdir(parents=True, exist_ok=True)
    output_labels.mkdir(parents=True, exist_ok=True)

    # 复制配置文件
    for config_file in ["classes.txt", "notes.json"]:
        src = input_path / config_file
        if src.exists():
            shutil.copy2(src, output_path / config_file)
            print(f"✓ 已复制 {config_file}")

    # 获取图像列表
    input_images_dir = input_path / "images"
    input_labels_dir = input_path / "labels"

    image_files = [f for f in input_images_dir.glob("*")
                  if f.suffix.lower() in {".jpg", ".jpeg", ".png", ".bmp"}]

    if not image_files:
        raise ValueError(f"在 {input_images_dir} 中未找到图像文件")

```

```

print(f"💡 发现 {len(image_files)} 张图像，开始处理...")
print_memory_usage()

# 逐张处理图像 (内存友好)
success_count = 0
for img_path in tqdm(image_files, desc="处理进度"):
    try:
        # 使用with语句确保文件及时关闭
        with Image.open(img_path) as img:
            # 计算新尺寸
            new_size = (img.width // scale_factor,
                        img.height // scale_factor)

            # 使用LANCZOS重采样 (高质量) 并立即保存
            img_resized = img.resize(new_size, Image.Resampling.LANCZOS)
            output_img_path = output_images / img_path.name
            img_resized.save(output_img_path, quality=95, optimize=True)

        # 直接复制对应的标签文件 (关键优化点)
        label_path = input_labels_dir / f"{img_path.stem}.txt"
        if label_path.exists():
            shutil.copy2(label_path, output_labels /
                         f"{img_path.stem}.txt")

        success_count += 1

        # 每50张图像打印一次内存状态
        if success_count % 50 == 0:
            print(f"\n⌚ 已处理 {success_count}/{len(image_files)} 张图像")
            print_memory_usage()

    except Exception as e:
        print(f"✖ 处理失败 {img_path.name}: {str(e)}")
        continue

    print(f"\n✓ 处理完成！成功: {success_count}/{len(image_files)}")
    print_memory_usage()

return output_path, success_count

```

In [55]:

```

# 步骤6：执行数据集处理
print(f"📌 开始处理数据集: {INPUT_FOLDER}")
print(f"📏 缩小因子: 1/{SCALE_FACTOR}")
print("=" * 60)

output_dataset_path, processed_count = create_downsampled_dataset(
    input_folder=INPUT_FOLDER,
    scale_factor=SCALE_FACTOR
)

print(f"\n⌚ 新数据集路径: {output_dataset_path}")

```

开始处理数据集: data/1210-403  
缩小因子: 1/4

=====

- ✓ 已复制 classes.txt
- ✓ 已复制 notes.json
- 发现 403 张图像, 开始处理...
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.44GB(已用) / 15.81GB(总计) / 72.3%

=====

处理进度: 0% | 0/403 [00:00<?, ?it/s]

- 已处理 50/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.49GB(已用) / 15.81GB(总计) / 72.7%

=====

- 已处理 100/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.51GB(已用) / 15.81GB(总计) / 72.8%

=====

- 已处理 150/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.58GB(已用) / 15.81GB(总计) / 73.2%

=====

- 已处理 200/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.55GB(已用) / 15.81GB(总计) / 73.1%

=====

- 已处理 250/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.52GB(已用) / 15.81GB(总计) / 72.9%

=====

- 已处理 300/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.53GB(已用) / 15.81GB(总计) / 72.9%

=====

- 已处理 350/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.56GB(已用) / 15.81GB(总计) / 73.1%

=====

- 已处理 400/403 张图像
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.54GB(已用) / 15.81GB(总计) / 73.0%

=====

- 处理完成! 成功: 403/403
- GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)
- 系统内存: 11.54GB(已用) / 15.81GB(总计) / 73.0%

=====

新数据集路径: data\1210-403-det

In [56]: # 步骤7: 创建YOLO配置文件

```
def create_yolo_config(dataset_path: Path):
    """创建YOLO训练用的yaml配置文件"""

```

```

# 读取类别
classes_file = dataset_path / "classes.txt"
class_names = {}
if classes_file.exists():
    with open(classes_file, 'r', encoding='utf-8') as f:
        classes = [line.strip() for line in f if line.strip()]
        class_names = {i: name for i, name in enumerate(classes)}

# 单类模式（忽略分类，专注检测）
# 将所有类别合并为"target"
config = {
    'path': str(dataset_path),
    'train': 'images',
    'val': 'images', # 注意：实际项目中应单独划分验证集
    'nc': 1, # 强制单类
    'names': {0: 'target'} # 所有目标归为"target"类
}

config_path = dataset_path / "dataset.yaml"
with open(config_path, 'w', encoding='utf-8') as f:
    yaml.dump(config, f, default_flow_style=False, allow_unicode=True)

print(f"配置文件已创建: {config_path}")
print(f"类别配置: {config['names']}")
return config_path

```

```
config_path = create_yolo_config(output_dataset_path)
```

配置文件已创建: data\1210-403-det\dataset.yaml  
类别配置: {0: 'target'}

In [57]:

```

# 步骤8：配置YOLO训练参数 (4050 Laptop专用优化)
def get_train_config(config_path: str):
    """获取针对RTX 4050 Laptop优化的训练配置"""
    return {
        # 基础配置
        'data': config_path,
        'epochs': 100, # 适中轮数
        'imgsz': IMAGE_SIZE, # 图像尺寸
        'batch': BATCH_SIZE, # 批大小 (6GB显存安全值)

        # 设备配置
        'device': 0, # GPU编号
        'workers': 1, # 数据加载线程 (减少内存占用)

        # 显存优化 (关键)
        'amp': True, # 混合精度训练 (必备)
        'cache': 'disk', # 磁盘缓存 (节省内存)
        # 'fraction': 0.95, # 使用95%显存

        # 模型配置
        'model': 'yolov8n.pt', # nano模型 (最小显存占用)
        # 'single_cls': True, # 单类模式 (忽略分类)
        'pretrained': True, # 使用预训练权重

        # 优化器
        'optimizer': 'AdamW', # AdamW收敛更快
        'lr0': 0.0001, # 0.0005比较保守
        'cos_lr': True, # 新增: 余弦退火调度
    }

```

```

    'warmup_epochs': 3,           # 新增: 预热轮数
    'weight_decay': 0.0005,       # 新增: 权重衰减
    # 'dropout': 0.2,            # 新增: 轻度Dropout防过拟合
    'conf': 0.05,

    # 早停机制
    'patience': 10,             # 10轮无改善则停止

    # 数据增强强化
    'mosaic': 0.5,
    'copy_paste': 0.1,
    'mixup': 0.0,
    'degrees': 5,
    'perspective': 0.0,

    # Loss权重 (专注定位)
    # 'box': 15,                  # 提升框回归Loss权重
    # 'cls': 0.5,                 # 降低分类Loss权重
    # 'dfl': 1.5,

    # 其他
    'save': True,
    'verbose': True,
    'project': f'{output_dataset_path.parent}/yolo_runs',
    'name': f'{output_dataset_path.name}_train'
}

train_params = get_train_config(str(config_path))

print("💡 YOLO训练配置:")
for k, v in train_params.items():
    print(f"  {k}: {v}")
print("\n⚠️ 重要提示:")
print("  - 每轮训练后自动清理显存")
print("  - 使用混合精度减少50%显存占用")
print("  - 单类模式忽略分类, 专注框选精度")
print("=" * 60)
print_memory_usage()

```

💡 YOLO训练配置:

```
data: data\1210-403-det\dataset.yaml
epochs: 100
imgsz: 640
batch: 16
device: 0
workers: 1
amp: True
cache: disk
model: yolov8n.pt
pretrained: True
optimizer: AdamW
lr0: 0.0001
cos_lr: True
warmup_epochs: 3
weight_decay: 0.0005
conf: 0.05
patience: 10
mosaic: 0.5
copy_paste: 0.1
mixup: 0.0
degrees: 5
perspective: 0.0
save: True
verbose: True
project: data/yolo_runs
name: 1210-403-det_train
```

⚠ 重要提示:

- 每轮训练后自动清理显存
- 使用混合精度减少50%显存占用
- 单类模式忽略分类，专注框选精度

```
=====
```

GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)  
系统内存: 11.49GB(已用) / 15.81GB(总计) / 72.7%

---

```
In [58]: # 步骤9: 开始训练 (核心步骤)
from ultralytics import YOLO

# 再次清理显存
torch.cuda.empty_cache()
print("🚀 初始化YOLO模型...")

# 加载模型 (首次运行会自动下载权重)
model = YOLO(train_params['model'])
print(f"✅ 模型加载完成: {train_params['model']}")
```

🚀 初始化YOLO模型...
✅ 模型加载完成: yolov8n.pt  
GPU显存: 0.03GB(已用) / 0.03GB(保留) / 1.93GB(峰值)  
系统内存: 11.49GB(已用) / 15.81GB(总计) / 72.7%

---

```
In [59]: # 步骤10: 执行训练 (带异常处理和内存监控)
```

```
try:
    print("\n🚀 开始训练! 目标: 提升小目标检测敏感度")
    print(f"📊 训练轮数: {train_params['epochs']} | 批大小: {train_params['batch']}")
    print("=" * 60)
```

```
# 训练模型
results = model.train(
    **{k: v for k, v in train_params.items() if k != 'model'})

print("\n✅ 训练完成!")
print(f"📁 模型保存路径: {train_params['project']}/{train_params['name']}")

except torch.cuda.OutOfMemoryError as e:
    print("\n❌ 显存不足错误!")
    print("💡 解决方案:")
    print("  1. 减小 BATCH_SIZE (当前: {})".format(BATCH_SIZE))
    print("  2. 减小 IMAGE_SIZE (当前: {})".format(IMAGE_SIZE))
    print("  3. 增大 SCALE_FACTOR (当前: {})".format(SCALE_FACTOR))
    print("  4. 重启Kernel后重试")

except Exception as e:
    print("\n❌ 训练出错: {}".format(type(e).__name__))
    print("📄 错误信息: {}".format(str(e)))

finally:
    # 最终清理
    torch.cuda.empty_cache()
    print("\n⚡ 显存清理完成")
    print_memory_usage()
```

⌚ 开始训练！目标：提升小目标检测敏感度

📊 训练轮数：100 | 批大小：16

```
=====
New https://pypi.org/project/ultralytics/8.3.238 available Update with 'pip install -U ultralytics'
Ultralytics 8.3.154 Python-3.11.7 torch-2.9.1+cu130 CUDA:0 (NVIDIA GeForce RTX 4050 Laptop GPU, 6140MiB)
engine\trainer: agnostic_nms=False, amp=True, augment=False, auto_augment=randaugment, batch=16, bgr=0.0, box=7.5, cache=disk, cfg=None, classes=None, close_mosaic=10, cls=0.5, conf=0.05, copy_paste=0.1, copy_paste_mode=flip, cos_lr=True, cutmix=0.0, data=data\1210-403-det\dataset.yaml, degrees=5, deterministic=True, device=0, dfl=1.5, dnn=False, dropout=0.0, dynamic=False, embed=None, epochs=100, erasing=0.4, exist_ok=False, fliplr=0.5, flipud=0.0, format=torchscript, fraction=1.0, freeze=None, half=False, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, imgsz=640, int8=False, iou=0.7, keras=False, kobj=1.0, line_width=None, lr0=0.0001, lrf=0.01, mask_ratio=4, max_det=300, mixup=0.0, mode=train, model=yolov8n.pt, momentum=0.937, moساic=0.5, multi_scale=False, name=1210-403-det_train4, nbs=64, nms=False, opset=None, optimize=False, optimizer=AdamW, overlap_mask=True, patience=10, perspective=0.0, plots=True, pose=12.0, pretrained=True, profile=False, project=data/yolo_runs, rect=False, resume=False, retina_masks=False, save=True, save_conf=False, save_crop=False, save_dir=data\yolo_runs\1210-403-det_train4, save_frames=False, save_json=False, save_period=-1, save_txt=False, scale=0.5, seed=0, shear=0.0, show=False, show_boxes=True, show_conf=True, show_labels=True, simplify=True, singlecls=False, source=None, split=val, stream_buffer=False, task=detect, time=None, tracker=botsort.yaml, translate=0.1, val=True, verbose=True, vid_stride=1, visualize=False, warmup_bias_lr=0.1, warmup_epochs=3, warmup_momentum=0.8, weight_decay=0.0005, workers=1, workspace=None
Overriding model.yaml nc=80 with nc=1
```

	from	n	params	module
arguments				
0		-1	1	464 ultralytics.nn.modules.conv.Conv
[3, 16, 3, 2]				
1		-1	1	4672 ultralytics.nn.modules.conv.Conv
[16, 32, 3, 2]				
2		-1	1	7360 ultralytics.nn.modules.block.C2f
[32, 32, 1, True]				
3		-1	1	18560 ultralytics.nn.modules.conv.Conv
[32, 64, 3, 2]				
4		-1	2	49664 ultralytics.nn.modules.block.C2f
[64, 64, 2, True]				
5		-1	1	73984 ultralytics.nn.modules.conv.Conv
[64, 128, 3, 2]				
6		-1	2	197632 ultralytics.nn.modules.block.C2f
[128, 128, 2, True]				
7		-1	1	295424 ultralytics.nn.modules.conv.Conv
[128, 256, 3, 2]				
8		-1	1	460288 ultralytics.nn.modules.block.C2f
[256, 256, 1, True]				
9		-1	1	164608 ultralytics.nn.modules.block.SPPF
[256, 256, 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	148224 ultralytics.nn.modules.block.C2f
[384, 128, 1]				
13		-1	1	0 torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']				
14		[-1, 4]	1	0 ultralytics.nn.modules.conv.Concat

```
[1]          -1  1    37248 ultralytics.nn.modules.block.C2f
[192, 64, 1]
[16          -1  1    36992 ultralytics.nn.modules.conv.Conv
[64, 64, 3, 2]
[17          [-1, 12] 1      0 ultralytics.nn.modules.conv.Concat
[1]
[18          -1  1    123648 ultralytics.nn.modules.block.C2f
[192, 128, 1]
[19          -1  1    147712 ultralytics.nn.modules.conv.Conv
[128, 128, 3, 2]
[20          [-1, 9] 1      0 ultralytics.nn.modules.conv.Concat
[1]
[21          -1  1    493056 ultralytics.nn.modules.block.C2f
[384, 256, 1]
[22          [15, 18, 21] 1    751507 ultralytics.nn.modules.head.Detect
[1, [64, 128, 256]]
Model summary: 129 layers, 3,011,043 parameters, 3,011,027 gradients, 8.2 GFLOPs
```

Transferred 319/355 items from pretrained weights

Freezing layer 'model.22.dfl.conv.weight'

**AMP:** running Automatic Mixed Precision (AMP) checks...

**AMP:** checks passed

**train:** Fast image access (ping: 0.20.0 ms, read: 877.4269.7 MB/s, size: 155.8 KB)

**train:** Scanning D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\labels...
403 images, 0 backgrounds, 397 corrupt: 100%|██████████| 403/403 [00:00<00:00, 31
37.10it/s]







































```
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160238.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160256.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160300.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160305.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160311.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160315.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160321.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160323.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160413.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160416.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160417.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160422.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160435.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160442.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160447.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160455.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0  
train: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG_20251  
209_160500.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0
```

```
train: New cache created: D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det  
\labels.cache
```

```
train: Caching images (0.0GB Disk): 100%|██████████| 6/6 [00:00<00:00, 695.02it/  
s]
```

```
val: Fast image access (ping: 0.10.0 ms, read: 1171.8260.6 MB/s, size: 156.2 KB)
```

```
val: Scanning D:\Ma_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\labels.cach  
e... 403 images, 0 backgrounds, 397 corrupt: 100%|██████████| 403/403 [00:00<?, ?  
it/s]
```







































**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160238.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160256.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160300.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160305.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160311.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160315.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160321.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160323.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160413.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160416.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160417.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160422.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160435.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160442.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160447.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160455.jpg: ignoring corrupt image/label: Label class 2 exceeds dataset class  
count 1. Possible class labels are 0-0

**train:** D:\Ma\_Siyuan\Personal\Code\FlyMorpher\data\1210-403-det\images\MVIMG\_20251  
209\_160500.jpg: ignoring corrupt image/label: Label class 1 exceeds dataset class  
count 1. Possible class labels are 0-0

**val:** Caching images (0.0GB Disk): 100% |██████████| 6/6 [00:00<00:00, 3004.52it/s]

Plotting labels to data\yolo\_runs\1210-403-det\_train4\labels.jpg...  
**optimizer:** AdamW(lr=0.0001, momentum=0.937) with parameter groups 57 weight(decay=0.0), 64 weight(decay=0.0005), 63 bias(decay=0.0)  
Image sizes 640 train, 640 val  
Using 1 dataloader workers  
Logging results to data\yolo\_runs\1210-403-det\_train4  
Starting training for 100 epochs...

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
1/100	0.779G	2.067	3.475	1.966	10	640: 10
0%  ██████████  1/1 [00:01<00:00, 1.34s/it]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 5.48it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
2/100	0.785G	2.122	3.497	2.316	12	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.04it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 26.02it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
3/100	0.793G	1.898	3.33	2.13	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 4.88it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 25.31it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
4/100	0.793G	1.678	3.477	2.045	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 11.96it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.47it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
5/100	0.793G	2.21	3.882	2.094	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 11.55it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.57it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
6/100	0.799G	1.686	3.422	2.112	7	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.26it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.01it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
7/100	0.824G	1.625	3.392	1.991	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.90it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.26it/s]						
	all	6	6	0	0	0
0						

0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
8/100	0.824G	1.779	3.395	2.098	7	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.42it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 32.46it/s]	all	6	6	0	0	0
0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
9/100	0.824G	1.446	3.17	1.771	7	640: 10
0%  ██████████  1/1 [00:00<00:00, 14.18it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.30it/s]	all	6	6	0	0	0
0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
10/100	0.84G	1.447	2.947	1.825	15	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.79it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 33.31it/s]	all	6	6	0	0	0
0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
11/100	0.84G	1.512	2.891	1.616	13	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.33it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.76it/s]	all	6	6	0	0	0
0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
12/100	0.842G	1.613	2.979	2.026	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.46it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.98it/s]	all	6	6	0	0	0
0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
13/100	0.842G	1.273	2.343	1.542	13	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.42it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 32.26it/s]	all	6	6	0	0	0
0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
14/100	0.857G	1.313	2.232	1.583	12	640: 10
0%  ██████████  1/1 [00:00<00:00, 11.82it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.28it/s]	all	6	6	0	0	0
0	all	6	6	0	0	0
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size

15/100	0.857G	1.641	2.922	2.075	8	640: 10
0%  ██████████  1/1 [00:00<00:00, 11.66it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.93it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
16/100	0.857G	1.568	2.77	1.678	12	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.98it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.93it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
17/100	0.857G	1.698	2.609	1.754	12	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.83it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.84it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
18/100	0.873G	1.563	2.74	1.888	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 17.16it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 33.88it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
19/100	0.885G	1.421	2.38	1.638	15	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.89it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.52it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
20/100	0.885G	1.088	2.408	1.787	7	640: 10
0%  ██████████  1/1 [00:00<00:00, 17.24it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.17it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
21/100	0.885G	1.142	2.053	1.392	14	640: 10
0%  ██████████  1/1 [00:00<00:00, 14.14it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 32.47it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
22/100	0.885G	1.349	2.273	1.497	6	640: 10
0%  ██████████  1/1 [00:00<00:00, 16.39it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.97it/s]	all	6	6	0	0	0
0						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
23/100	0.9G	1.356	2.141	1.692	10	640: 10
0%   ██████████   1/1 [00:00<00:00, 13.07it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 30.73it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
24/100	0.9G	1.626	2.127	1.931	8	640: 10
0%   ██████████   1/1 [00:00<00:00, 15.27it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 29.44it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
25/100	0.9G	1.49	2.636	1.867	7	640: 10
0%   ██████████   1/1 [00:00<00:00, 13.34it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 31.25it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
26/100	0.9G	0.895	2.179	1.459	8	640: 10
0%   ██████████   1/1 [00:00<00:00, 15.48it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 31.25it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
27/100	0.9G	1.268	2.16	1.431	8	640: 10
0%   ██████████   1/1 [00:00<00:00, 12.96it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 30.30it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
28/100	0.9G	1.167	1.902	1.425	13	640: 10
0%   ██████████   1/1 [00:00<00:00, 16.26it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 27.78it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
29/100	0.9G	0.7808	1.523	1.288	11	640: 10
0%   ██████████   1/1 [00:00<00:00, 12.53it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 28.98it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
30/100	0.9G	1.24	2.038	1.497	11	640: 10
0%   ██████████   1/1 [00:00<00:00, 16.80it/s]						
Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 31.55it/s]						
all	6	6	0	0	0	0
0						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
31/100	0.9G	1.617	1.772	1.577	13	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.42it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.84it/s]					0	0
all 6 6 0 0 0						
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
32/100	0.9G	1.396	1.854	1.476	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.14it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 32.78it/s]					0	0
all 6 6 0 0 0						
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
33/100	0.9G	1.399	2.363	1.856	8	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.66it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.88it/s]					0	0
all 6 6 0 0 0						
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
34/100	0.9G	1.197	1.645	1.341	10	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.83it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.83it/s]					0	0
all 6 6 0 0 0						
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
35/100	0.9G	1.348	1.917	1.417	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.81it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.70it/s]					0	0
all 6 6 0 0 0						
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
36/100	0.9G	1.232	1.631	1.363	12	640: 10
0%  ██████████  1/1 [00:00<00:00, 16.27it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.57it/s]					0	0
all 6 6 0 0 0						
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
37/100	0.9G	1.348	1.916	1.428	6	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.68it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.25it/s]					0	0
all 6 6 0 0 0						
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
38/100	0.9G	1.248	1.566	1.325	16	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.75it/s]						
Class Images Instances Box(P)					R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.38it/s]					0	0
all 6 6 0 0 0						

0		all	6	6	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	39/100	0.9G	1.194	1.492	1.524	10	640: 10
0% ██████████  1/1 [00:00<00:00, 13.08it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100% ██████████  1/1 [00:00<00:00, 33.15it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	40/100	0.9G	0.9422	1.64	1.334	7	640: 10
0% ██████████  1/1 [00:00<00:00, 15.75it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100% ██████████  1/1 [00:00<00:00, 31.31it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	41/100	0.922G	1.351	1.158	1.454	9	640: 10
0% ██████████  1/1 [00:00<00:00, 13.17it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100% ██████████  1/1 [00:00<00:00, 32.25it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	42/100	0.922G	1.721	1.515	1.537	13	640: 10
0% ██████████  1/1 [00:00<00:00, 16.00it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100% ██████████  1/1 [00:00<00:00, 28.57it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	43/100	0.924G	1.295	1.201	1.389	9	640: 10
0% ██████████  1/1 [00:00<00:00, 12.99it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100% ██████████  1/1 [00:00<00:00, 30.30it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	44/100	0.924G	0.9785	1.307	1.203	9	640: 10
0% ██████████  1/1 [00:00<00:00, 15.50it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100% ██████████  1/1 [00:00<00:00, 29.90it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	45/100	0.941G	1.089	1.247	1.265	15	640: 10
0% ██████████  1/1 [00:00<00:00, 12.31it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100% ██████████  1/1 [00:00<00:00, 31.74it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size

46/100	0.941G	1.352	1.493	1.592	10	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.37it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 33.33it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
47/100	0.941G	1.46	1.625	1.721	10	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.79it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 27.69it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
48/100	0.941G	1.357	1.372	1.55	7	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.14it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.17it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
49/100	0.941G	1.314	2.392	1.864	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.23it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.91it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
50/100	0.941G	0.9894	1.278	1.214	12	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.74it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.57it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
51/100	0.941G	1.105	1.375	1.341	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.66it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.46it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
52/100	0.941G	1.209	1.101	1.393	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 16.12it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.49it/s]	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
53/100	0.941G	1.397	1.733	1.386	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.50it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.30it/s]	all	6	6	0	0	0
0						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
54/100	0.941G	1.101	1.786	1.799	7	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.86it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.41it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
55/100	0.941G	1.07	1.445	1.215	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 16.98it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.25it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
56/100	0.941G	1.389	1.232	1.524	10	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.37it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 32.55it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
57/100	0.941G	1.192	1.397	1.393	12	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.28it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.41it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
58/100	0.941G	1	1.506	1.353	10	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.40it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 32.26it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
59/100	0.941G	1.136	1.278	1.285	6	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.21it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.30it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
60/100	0.941G	1.078	0.9314	1.242	10	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.31it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 32.05it/s]						
	all	6	6	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
61/100	0.941G	0.8555	1.135	1.338	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.71it/s]						
	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 33.14it/s]						
	all	6	6	0	0	0
0						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
62/100	0.941G	1.205	1.634	1.46	10	640: 10
0%  ██████████  1/1 [00:00<00:00, 14.72it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 31.25it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
63/100	0.941G	1.344	1.392	1.295	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.90it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.97it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
64/100	0.941G	0.9709	1.071	1.125	8	640: 10
0%  ██████████  1/1 [00:00<00:00, 16.00it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 29.42it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
65/100	0.941G	0.9933	1.237	1.311	6	640: 10
0%  ██████████  1/1 [00:00<00:00, 16.29it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 28.95it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
66/100	0.941G	1.683	1.398	1.791	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 12.77it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 27.91it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
67/100	0.941G	0.8585	1.25	1.136	7	640: 10
0%  ██████████  1/1 [00:00<00:00, 16.02it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.76it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
68/100	0.941G	1.234	1.368	1.412	9	640: 10
0%  ██████████  1/1 [00:00<00:00, 15.63it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.76it/s]						
all	6	6	0	0	0	0
0						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
69/100	0.941G	1.31	1.238	1.51	11	640: 10
0%  ██████████  1/1 [00:00<00:00, 13.01it/s]						
Class	Images	Instances	Box(P)		R	mAP50 mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 30.31it/s]						

0	all	6	6	0	0	0	
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	70/100	0.941G	1.146	1.311	1.463	9	640: 10
0%   [██████  1/1 [00:00<00:00, 16.13it/s]	Class	Images	Instances	Box(P	R	mAP50	mA
P50-95): 100%   [██████  1/1 [00:00<00:00, 27.64it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	71/100	0.941G	1.215	1.953	1.63	11	640: 10
0%   [██████  1/1 [00:00<00:00, 15.50it/s]	Class	Images	Instances	Box(P	R	mAP50	mA
P50-95): 100%   [██████  1/1 [00:00<00:00, 32.26it/s]	all	6	6	0	0	0	0
0	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	72/100	0.941G	0.8421	0.7776	1.15	7	640: 10
0%   [██████  1/1 [00:00<00:00, 13.00it/s]	Class	Images	Instances	Box(P	R	mAP50	mA
P50-95): 100%   [██████  1/1 [00:00<00:00, 27.94it/s]	all	6	6	1	0.167	0.583	0.35
0.35	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	73/100	0.941G	1.297	1.468	1.469	7	640: 10
0%   [██████  1/1 [00:00<00:00, 16.42it/s]	Class	Images	Instances	Box(P	R	mAP50	mA
P50-95): 100%   [██████  1/1 [00:00<00:00, 28.58it/s]	all	6	6	1	0.167	0.583	0.35
0.35	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	74/100	0.941G	1.239	1.704	1.511	12	640: 10
0%   [██████  1/1 [00:00<00:00, 15.88it/s]	Class	Images	Instances	Box(P	R	mAP50	mA
P50-95): 100%   [██████  1/1 [00:00<00:00, 29.73it/s]	all	6	6	1	0.167	0.583	0.35
0.35	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	75/100	0.941G	1.378	1.923	1.495	17	640: 10
0%   [██████  1/1 [00:00<00:00, 12.80it/s]	Class	Images	Instances	Box(P	R	mAP50	mA
P50-95): 100%   [██████  1/1 [00:00<00:00, 30.30it/s]	all	6	6	1	0.333	0.667	0.35
0.35	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
0%	76/100	0.941G	1.149	1.313	1.555	8	640: 10
0%   [██████  1/1 [00:00<00:00, 16.81it/s]	Class	Images	Instances	Box(P	R	mAP50	mA
P50-95): 100%   [██████  1/1 [00:00<00:00, 28.29it/s]	all	6	6	1	0.333	0.667	0.35
0.35	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size

	77/100	0.941G	0.9695	1.33	1.091	8	640: 10
0% ██████████	1/1 [00:00<00:00, 16.16it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 28.34it/s]	all	6	6	1	0.333	0.667
0.35							
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
78/100	0.941G	1.361	1.63	1.65	9	640: 10	
0% ██████████	1/1 [00:00<00:00, 12.65it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 28.58it/s]	all	6	6	1	0.5	0.75
0.425							
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
79/100	0.941G	0.8862	1.441	1.291	8	640: 10	
0% ██████████	1/1 [00:00<00:00, 15.74it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 26.95it/s]	all	6	6	1	0.5	0.75
0.425							
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
80/100	0.941G	0.8955	1.021	1.132	10	640: 10	
0% ██████████	1/1 [00:00<00:00, 15.50it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 28.57it/s]	all	6	6	1	0.5	0.75
0.425							
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
81/100	0.941G	0.8433	1.462	1.322	7	640: 10	
0% ██████████	1/1 [00:00<00:00, 11.97it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 24.36it/s]	all	6	6	1	0.667	0.833
0.508							
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
82/100	0.941G	1.505	1.053	1.82	7	640: 10	
0% ██████████	1/1 [00:00<00:00, 16.71it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 27.57it/s]	all	6	6	1	0.667	0.833
0.508							
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
83/100	0.941G	1.001	1.366	1.395	9	640: 10	
0% ██████████	1/1 [00:00<00:00, 15.35it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 26.66it/s]	all	6	6	1	0.667	0.833
0.508							
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
84/100	0.941G	0.8819	0.9844	1.162	7	640: 10	
0% ██████████	1/1 [00:00<00:00, 12.05it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100% ██████████	1/1 [00:00<00:00, 28.57it/s]	all	6	6	1	0.667	0.833
0.577							

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
85/100	0.941G	1.06	1.16	1.251	9	640: 10
0%   ██████████   1/1 [00:00<00:00, 15.62it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 25.97it/s]	all	6	6	1	0.667	0.833
0.577						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
86/100	0.941G	0.7013	1.016	1.217	6	640: 10
0%   ██████████   1/1 [00:00<00:00, 15.94it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 28.49it/s]	all	6	6	1	0.667	0.833
0.577						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
87/100	0.941G	0.9554	1.293	1.211	10	640: 10
0%   ██████████   1/1 [00:00<00:00, 15.93it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 26.52it/s]	all	6	6	1	0.667	0.833
0.577						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
88/100	0.941G	1.257	1.423	1.636	11	640: 10
0%   ██████████   1/1 [00:00<00:00, 12.06it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 24.79it/s]	all	6	6	1	0.833	0.917
0.652						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
89/100	0.941G	1.061	1.5	1.315	13	640: 10
0%   ██████████   1/1 [00:00<00:00, 16.12it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 24.39it/s]	all	6	6	1	0.833	0.917
0.652						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
90/100	0.941G	0.803	1.339	1.131	11	640: 10
0%   ██████████   1/1 [00:00<00:00, 14.94it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 27.27it/s]	all	6	6	1	0.833	0.917
0.652						
Closing dataloader mosaic						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
91/100	0.941G	0.7907	1.185	1.22	6	640: 10
0%   ██████████   1/1 [00:01<00:00, 1.89s/it]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 22.80it/s]	all	6	6	1	0.833	0.917
0.652						
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
92/100	0.941G	0.7233	0.9814	1.119	6	640: 10
0%   ██████████   1/1 [00:00<00:00, 12.20it/s]	Class	Images	Instances	Box(P)	R	mAP50 mA
P50-95): 100%   ██████████   1/1 [00:00<00:00, 23.78it/s]	all	6	6	1	0.833	0.917

		all	6	6	1	0.833	0.917
<b>0.706</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
93/100	0.941G	0.859	1.158	1.125	6	640: 10	
0%  ██████████  1/1 [00:00<00:00, 14.69it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 21.74it/s]							
	all	6	6	1	0.833	0.917	
<b>0.706</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
94/100	0.941G	0.8133	0.8925	1.042	6	640: 10	
0%  ██████████  1/1 [00:00<00:00, 13.55it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 22.51it/s]							
	all	6	6	1	0.833	0.917	
<b>0.706</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
95/100	0.941G	0.9579	1.255	1.138	6	640: 10	
0%  ██████████  1/1 [00:00<00:00, 14.72it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 22.99it/s]							
	all	6	6	1	0.833	0.917	
<b>0.706</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
96/100	0.941G	0.9391	1.386	1.303	6	640: 10	
0%  ██████████  1/1 [00:00<00:00, 11.49it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 23.25it/s]							
	all	6	6	1	0.833	0.917	
<b>0.735</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
97/100	0.941G	0.7474	1.264	1.208	6	640: 10	
0%  ██████████  1/1 [00:00<00:00, 15.30it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 24.07it/s]							
	all	6	6	1	0.833	0.917	
<b>0.735</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
98/100	0.941G	0.7087	0.9645	1.093	6	640: 10	
0%  ██████████  1/1 [00:00<00:00, 15.08it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 24.12it/s]							
	all	6	6	1	0.833	0.917	
<b>0.735</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
99/100	0.941G	0.7177	1.171	1.182	6	640: 10	
0%  ██████████  1/1 [00:00<00:00, 16.17it/s]	Class	Images	Instances	Box(P)	R	mAP50	mA
P50-95): 100%  ██████████  1/1 [00:00<00:00, 23.14it/s]							
	all	6	6	1	0.833	0.917	
<b>0.735</b>							
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	

```
100/100      0.941G    0.7766    1.184      1.187      6      640: 10
0%|[██████████| 1/1 [00:00<00:00, 12.38it/s]
          Class   Images Instances Box(P
P50-95): 100%|[██████████| 1/1 [00:00<00:00, 23.52it/s]
          all       6        6       1      0.833     0.917
          0.735
```

100 epochs completed in 0.010 hours.

Optimizer stripped from data\yolo\_runs\1210-403-det\_train4\weights\last.pt, 6.3MB  
Optimizer stripped from data\yolo\_runs\1210-403-det\_train4\weights\best.pt, 6.3MB

Validating data\yolo\_runs\1210-403-det\_train4\weights\best.pt...

Ultralytics 8.3.154 Python-3.11.7 torch-2.9.1+cu130 CUDA:0 (NVIDIA GeForce RTX 4050 Laptop GPU, 6140MiB)

Model summary (fused): 72 layers, 3,005,843 parameters, 0 gradients, 8.1 GFLOPs

```
          Class   Images Instances Box(P
P50-95): 100%|[██████████| 1/1 [00:00<00:00, 22.46it/s]
          all       6        6       1      0.833     0.917
```

0.735

Speed: 0.3ms preprocess, 2.0ms inference, 0.0ms loss, 0.9ms postprocess per image  
Results saved to data\yolo\_runs\1210-403-det\_train4

✓ 训练完成!

📁 模型保存路径: data/yolo\_runs/1210-403-det\_train

🧹 显存清理完成

📊 GPU显存: 0.08GB(已用) / 0.25GB(保留) / 1.93GB(峰值)

💻 系统内存: 12.90GB(已用) / 15.81GB(总计) / 81.6%

---

In [60]: # 最终内存状态

```
print("\n📊 最终资源状态:")
print_memory_usage()
```

📊 最终资源状态:

📊 GPU显存: 0.08GB(已用) / 0.25GB(保留) / 1.93GB(峰值)

💻 系统内存: 12.90GB(已用) / 15.81GB(总计) / 81.6%

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