

ATFL自适应阈值焦点损失

[参考视频](#)

[参考代码](#)

修改

/ultralytics/utils/loss.py 文件中添加

```
1 class AdaptiveThresholdFocalLoss(nn.Module):
2     # wraps focal loss around existing loss_fcn(), i.e. criteria =
3     FocalLoss(nn.BCEWithLogitsLoss(), gamma=1.5)
4     def __init__(self, loss_fcn, gamma=1.5, alpha=0.25):
5         super(AdaptiveThresholdFocalLoss, self).__init__()
6         self.loss_fcn = loss_fcn # must be nn.BCEWithLogitsLoss()
7         self.gamma = gamma
8         self.alpha = alpha
9         # self.reduction = loss_fcn.reduction
10        # self.loss_fcn.reduction = 'none' # required to apply FL to each
11        element
12
13    def forward(self, pred, true):
14        loss = self.loss_fcn(pred, true)
15        pred_prob = torch.sigmoid(pred)
16        p_t = true * pred_prob + (1 - true) * (1 - pred_prob) # 得出预测概率
17        p_t = torch.Tensor(p_t) # 将张量转化为pytorch张量，使其在pytorch中可以进行张量运算
18
19        mean_pt = p_t.mean()
20        p_t_list = []
21        p_t_list.append(mean_pt)
22        p_t_old = sum(p_t_list) / len(p_t_list)
23        p_t_new = 0.05 * p_t_old + 0.95 * mean_pt
24        # gamma = 2
25        gamma = -torch.log(p_t_new)
26        # 处理大于0.5的元素
27        p_t_high = torch.where(p_t > 0.5, (1.000001 - p_t) ** gamma,
28        torch.zeros_like(p_t))
29
30        # 处理小于0.5的元素
31        p_t_low = torch.where(p_t <= 0.5, (1.5 - p_t) ** (-torch.log(p_t)),
32        torch.zeros_like(p_t)) # 将两部分结果相加
33        modulating_factor = p_t_high + p_t_low
34        loss *= modulating_factor
35        # if self.reduction == 'mean':
36        #     return loss.mean()
37        # elif self.reduction == 'sum':
38        #     return loss.sum()
39        # else: # 'none'
40        return loss
```

并在 v8DetectionLoss 类中修改

```
1 class v8DetectionLoss:
2     """Criterion class for computing training losses for YOLOv8 object
3     detection."""
4
5     def __init__(self, model, tal_topk=10): # model must be de-paralleled
6         """Initialize v8DetectionLoss with model parameters and task-aligned
7         assignment settings."""
8
9         device = next(model.parameters()).device # get model device
10        h = model.args # hyperparameters
11
12        m = model.model[-1] # Detect() module
13        self.bce = nn.BCEWithLogitsLoss(reduction="none")
14        # 这里添加
15        self.hyp = h
16        self.stride = m.stride # model strides
17        self.nc = m.nc # number of classes
18        self.no = m.nc + m.reg_max * 4
19        self.reg_max = m.reg_max
20        self.device = device
21
22        self.use_dfl = m.reg_max > 1
23
24        self.assigner = TaskAlignedAssigner(topk=tal_topk,
25        num_classes=self.nc, alpha=0.5, beta=6.0)
26        self.bbox_loss = BboxLoss(m.reg_max).to(device)
27        self.proj = torch.arange(m.reg_max, dtype=torch.float,
28        device=device)
```

为

```
1 class v8DetectionLoss:
2     """Criterion class for computing training losses for YOLOv8 object
3     detection."""
4
5     def __init__(self, model, tal_topk=10): # model must be de-paralleled
6         """Initialize v8DetectionLoss with model parameters and task-aligned
7         assignment settings."""
8
9         device = next(model.parameters()).device # get model device
10        h = model.args # hyperparameters
11
12        m = model.model[-1] # Detect() module
13        self.bce = nn.BCEWithLogitsLoss(reduction="none")
14        # 这里添加
15        # Focal loss
16        g = 1 # focal loss gamma
17        if g > 0:
18            self.bce = AdaptiveThresholdFocalLoss(self.bce, g)
19
20        self.hyp = h
21        self.stride = m.stride # model strides
22        self.nc = m.nc # number of classes
23        self.no = m.nc + m.reg_max * 4
```

```

21 self.reg_max = m.reg_max
22 self.device = device
23
24 self.use_dfl = m.reg_max > 1
25
26 self.assigner = TaskAlignedAssigner(topk=tal_topk,
num_classes=self.nc, alpha=0.5, beta=6.0)
27 self.bbox_loss = BboxLoss(m.reg_max).to(device)
28 self.proj = torch.arange(m.reg_max, dtype=torch.float,
device=device)

```

结果

```

dent-detector watch
195/200 4.38G 0.4579 0.3887 1.207 9 640: 100% 20/20 [00:42:00:00, 2.12s/it]
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:03:00:00, 3.00s/it]
all 29 29 0.878 0.793 0.893 0.505

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
196/200 4.38G 0.4489 0.3553 1.166 8 640: 100% 20/20 [00:42:00:00, 2.15s/it]
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:03:00:00, 3.03s/it]
all 29 29 0.886 0.802 0.902 0.491

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
197/200 4.38G 0.4416 0.3588 1.197 8 640: 100% 20/20 [00:41:00:00, 2.07s/it]
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:03:00:00, 3.02s/it]
all 29 29 0.892 0.854 0.902 0.5

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
198/200 4.38G 0.439 0.3289 1.165 8 640: 100% 20/20 [00:43:00:00, 2.18s/it]
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:03:00:00, 3.22s/it]
all 29 29 0.887 0.897 0.9 0.494

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
199/200 4.38G 0.4505 0.3629 1.184 8 640: 100% 20/20 [00:42:00:00, 2.15s/it]
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:02:00:00, 2.95s/it]
all 29 29 0.885 0.897 0.897 0.498

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
200/200 4.38G 0.4441 0.3536 1.184 8 640: 100% 20/20 [00:41:00:00, 2.05s/it]
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:03:00:00, 3.01s/it]
all 29 29 0.894 0.897 0.912 0.504

200 epochs completed in 2.471 hours.
Optimizer stripped from /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train20/weights/last.pt, 4.9MB
Optimizer stripped from /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train20/weights/best.pt, 4.9MB

Validating /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train20/weights/best.pt...
Ultralytics 8.3.114 Python-3.10.12 torch-2.4.1+cu124 CUDA:0 (NVIDIA GeForce RTX 3050 Laptop GPU, 4096MiB)
YOLO11_GhostConv summary (fused): 107 layers, 2,256,651 parameters, 0 gradients
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00:00:00, 2.74it/s]
all 29 29 0.97 0.931 0.957 0.561
Speed: 0.6ms preprocess, 5.6ms inference, 0.0ms loss, 1.7ms postprocess per image
Results saved to /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train20
(ml) yolo-accident-detector git:(feature/zd) X

```

- 1 (ml) → yolo-accident-detector git:(feature/zd) X python yolo11_GhostConv_train.py
- 2 WARNING ⚠ no model scale passed. Assuming scale='n'.
- 3 Transferred 457/541 items from pretrained weights
- 4 Ultralytics 8.3.114 🚀 Python-3.10.12 torch-2.4.1+cu124 CUDA:0 (NVIDIA GeForce RTX 3050 Laptop GPU, 4096MiB)







```

5 engine/trainer: task=detect, mode=train,
  model=ultralytics/cfg/models/11/yolo11n.pt, data=accident.yaml,
  epochs=200, time=None, patience=100, batch=16, imgs=640, save=True,
  save_period=-1, cache=False, device=0, workers=2, project=None,
  name=train20, exist_ok=False, pretrained=yolo11n.pt, optimizer=SGD,
  verbose=True, seed=0, deterministic=True, single_cls=False, rect=False,
  cos_lr=False, close_mosaic=10, resume=False, amp=False, 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, conf=None,
  iou=0.7, max_det=300, half=False, dnn=False, plots=True, source=None,
  vid_stride=1, stream_buffer=False, visualize=False, augment=False,
  agnostic_nms=False, classes=None, retina_masks=False, embed=None,
  show=False, save_frames=False, save_txt=False, save_conf=False,
  save_crop=False, show_labels=True, show_conf=True, show_boxes=True,
  line_width=None, format=torchscript, keras=False, optimize=False,
  int8=False, dynamic=False, simplify=True, opset=None, workspace=None,
  nms=False, lr0=0.01, lrf=0.01, momentum=0.937, weight_decay=0.0005,
  warmup_epochs=3.0, warmup_momentum=0.8, warmup_bias_lr=0.1, 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=0.0, translate=0.1, scale=0.5, shear=0.0,
  perspective=0.0, flipud=0.0, flip_lr=0.5, bgr=0.0, mosaic=1.0, mixup=0.0,
  copy_paste=0.0, copy_paste_mode=flip, auto_augment=randaugument, erasing=0.4,
  cfg=None, tracker=botsort.yaml, save_dir=/home/ubuntu22/Project/yolo-
  accident-detector/runs/detect/train20
6 Overriding model.yaml nc=80 with nc=1
7 WARNING ⚠ no model scale passed. Assuming scale='n'.
8

```

		from	n	params	module
	arguments				
10	0	-1	1	448	ultralytics.nn.modules.conv.GhostConv
	[3, 16, 3, 2]				
11	1	-1	1	2768	ultralytics.nn.modules.conv.GhostConv
	[16, 32, 3, 2]				
12	2	-1	1	6640	ultralytics.nn.modules.block.C3k2
	[32, 64, 1, False, 0.25]				
13	3	-1	1	19360	ultralytics.nn.modules.conv.GhostConv
	[64, 64, 3, 2]				
14	4	-1	1	26080	ultralytics.nn.modules.block.C3k2
	[64, 128, 1, False, 0.25]				
15	5	-1	1	75584	ultralytics.nn.modules.conv.GhostConv
	[128, 128, 3, 2]				
16	6	-1	1	87040	ultralytics.nn.modules.block.C3k2
	[128, 128, 1, True]				
17	7	-1	1	151168	ultralytics.nn.modules.conv.GhostConv
	[128, 256, 3, 2]				
18	8	-1	1	346112	ultralytics.nn.modules.block.C3k2
	[256, 256, 1, True]				
19	9	-1	1	164608	ultralytics.nn.modules.block.SPPF
	[256, 256, 5]				
20	10	-1	1	249728	ultralytics.nn.modules.block.C2PSA
	[256, 256, 1]				
21	11	-1	1	0	torch.nn.modules.upsampling.Upsample
	[None, 2, 'nearest']				
22	12	[-1, 6]	1	0	ultralytics.nn.modules.conv.Concat
	[1]				

```

23 13          -1 1    111296 ultralytics.nn.modules.block.C3k2
    [384, 128, 1, False]
24 14          -1 1         0 torch.nn.modules.upsampling.Upsample
    [None, 2, 'nearest']
25 15        [-1, 4] 1         0 ultralytics.nn.modules.conv.Concat
    [1]
26 16          -1 1    32096 ultralytics.nn.modules.block.C3k2
    [256, 64, 1, False]
27 17          -1 1    19360 ultralytics.nn.modules.conv.GhostConv
    [64, 64, 3, 2]
28 18        [-1, 13] 1         0 ultralytics.nn.modules.conv.Concat
    [1]
29 19          -1 1    86720 ultralytics.nn.modules.block.C3k2
    [192, 128, 1, False]
30 20          -1 1    75584 ultralytics.nn.modules.conv.GhostConv
    [128, 128, 3, 2]
31 21        [-1, 10] 1         0 ultralytics.nn.modules.conv.Concat
    [1]
32 22          -1 1   378880 ultralytics.nn.modules.block.C3k2
    [384, 256, 1, True]
33 23    [16, 19, 22] 1   430867 ultralytics.nn.modules.head.Detect
    [1, [64, 128, 256]]
34 YOLO11_GhostConv summary: 195 layers, 2,264,339 parameters, 2,264,323
    gradients
35
36 Transferred 490/541 items from pretrained weights
37 Freezing layer 'model.23.dfl.conv.weight'
38 train: Fast image access  (ping: 0.0±0.0 ms, read: 394.3±91.0 MB/s, size:
    66.7 KB)
39 train: Scanning
    /home/ubuntu22/Project/datasets/Accident_Detection.v1i.yolov8/train/labels.c
    ache... 312 images, 0 backgrounds, 0 corrupt: 100% 3
40 val: Fast image access  (ping: 0.1±0.1 ms, read: 101.5±17.3 MB/s, size:
    66.1 KB)
41 val: Scanning
    /home/ubuntu22/Project/datasets/Accident_Detection.v1i.yolov8/valid/labels.c
    ache... 29 images, 0 backgrounds, 0 corrupt: 100% 29/2
42 Plotting labels to /home/ubuntu22/Project/yolo-accident-
    detector/runs/detect/train20/labels.jpg...
43 optimizer: SGD(lr=0.01, momentum=0.937) with parameter groups 88
    weight(decay=0.0), 95 weight(decay=0.0005), 94 bias(decay=0.0)
44 Image sizes 640 train, 640 val
45 Using 2 dataloader workers
46 Logging results to /home/ubuntu22/Project/yolo-accident-
    detector/runs/detect/train20
47 Starting training for 200 epochs...
48
49      Epoch      GPU_mem    box_loss    cls_loss    dfl_loss  Instances
    Size
50      1/200      4.34G        2.76        3.534        3.037         24
    640: 100% 20/20 [00:43<00:00, 2.19s/it]
51              Class      Images  Instances      Box(P          R
    mAP50  mAP50-95): 100% 1/1 [00:06<00:00, 6.11s/it]
52              all         29         29      0.00299      0.897
    0.159      0.036

```

```

53
54      Epoch      GPU_mem    box_loss    cls_loss    dfl_loss    Instances
Size
55      2/200      4.37G      2.512      3.445      2.804      22
640: 100%|██████████| 20/20 [00:46<00:00, 2.35s/it]
56
57      Epoch      GPU_mem    box_loss    cls_loss    dfl_loss    Instances
Size
58      200/200    4.38G      0.4441     0.3536     1.184      8
640: 100%|██████████| 20/20 [00:41<00:00, 2.05s/it]
59              class      Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.01s/it]
60              all        29        29        0.894      0.897
0.912      0.504
61
62 200 epochs completed in 2.471 hours.
63 Optimizer stripped from /home/ubuntu22/Project/yolo-accident-
detector/runs/detect/train20/weights/last.pt, 4.9MB
64 Optimizer stripped from /home/ubuntu22/Project/yolo-accident-
detector/runs/detect/train20/weights/best.pt, 4.9MB
65
66 validating /home/ubuntu22/Project/yolo-accident-
detector/runs/detect/train20/weights/best.pt...
67 Ultralytics 8.3.114 🚀 Python-3.10.12 torch-2.4.1+cu124 CUDA:0 (NVIDIA
GeForce RTX 3050 Laptop GPU, 4096MiB)
68 YOLO11_GhostConv summary (fused): 107 layers, 2,256,651 parameters, 0
gradients
69              class      Images  Instances      Box(P          R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:00<00:00, 2.74it/s]
70              all        29        29        0.97      0.931
0.957      0.561
71 Speed: 0.6ms preprocess, 5.6ms inference, 0.0ms loss, 1.7ms postprocess per
image
72 Results saved to /home/ubuntu22/Project/yolo-accident-
detector/runs/detect/train20

```

```

. dent-detector x watch x + v
195/200      4.38G      0.441      0.3512      1.178      9      640: 100%|██████████| 20/20 [00:42<00:00, 2.11s/it]
Class      Images  Instances      Box(P          R
all        29        29        0.821      0.824      mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.38s/it]
0.824      0.424

Epoch      GPU_mem    box_loss    cls_loss    dfl_loss    Instances      Size
196/200    4.38G      0.4112     0.3197     1.137      8      640: 100%|██████████| 20/20 [00:38<00:00, 1.93s/it]
Class      Images  Instances      Box(P          R
all        29        29        0.828      0.876      mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.60s/it]
0.828      0.408

Epoch      GPU_mem    box_loss    cls_loss    dfl_loss    Instances      Size
197/200    4.38G      0.4083     0.3256     1.156      8      640: 100%|██████████| 20/20 [00:31<00:00, 1.55s/it]
Class      Images  Instances      Box(P          R
all        29        29        0.988      0.907      mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.16s/it]
0.988      0.407

Epoch      GPU_mem    box_loss    cls_loss    dfl_loss    Instances      Size
198/200    4.38G      0.4042     0.3064     1.138      8      640: 100%|██████████| 20/20 [00:32<00:00, 1.64s/it]
Class      Images  Instances      Box(P          R
all        29        29        0.992      0.91      mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.13s/it]
0.992      0.424

Epoch      GPU_mem    box_loss    cls_loss    dfl_loss    Instances      Size
199/200    4.38G      0.4241     0.3125     1.163      8      640: 100%|██████████| 20/20 [00:33<00:00, 1.66s/it]
Class      Images  Instances      Box(P          R
all        29        29        0.926      0.91      mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.29s/it]
0.926      0.433

Epoch      GPU_mem    box_loss    cls_loss    dfl_loss    Instances      Size
200/200    4.38G      0.4013     0.3003     1.143      8      640: 100%|██████████| 20/20 [00:33<00:00, 1.66s/it]
Class      Images  Instances      Box(P          R
all        29        29        0.961      0.916      mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.16s/it]
0.961      0.441

200 epochs completed in 2.288 hours.
Optimizer stripped from /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train21/weights/last.pt, 4.9MB
Optimizer stripped from /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train21/weights/best.pt, 4.9MB
Validating /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train21/weights/best.pt...
Ultralytics 8.3.114 🚀 Python-3.10.12 torch-2.4.1+cu124 CUDA:0 (NVIDIA GeForce RTX 3050 Laptop GPU, 4096MiB)
YOLO11_GhostConv summary (fused): 107 layers, 2,256,651 parameters, 0 gradients
Class      Images  Instances      Box(P          R
all        29        29        0.896      0.888      mAP50  mAP50-95): 100%|██████████| 1/1 [00:00<00:00, 2.63it/s]
0.896      0.509

Speed: 0.5ms preprocess, 5.5ms inference, 0.0ms loss, 1.8ms postprocess per image
Results saved to /home/ubuntu22/Project/yolo-accident-detector/runs/detect/train21
(ml) yolo-accident-detector git:(feature/2d) X

```

```

1      195/200      4.38G      0.441      0.3512      1.178      9
640: 100%|██████████| 20/20 [00:42<00:00, 2.11s/it]
2              Class      Images      Instances      Box(P      R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.38s/it]
3              all      29      29      0.821      0.828
0.824      0.424
4
5      Epoch      GPU_mem      box_loss      cls_loss      dfl_loss      Instances
Size
6      196/200      4.38G      0.4112      0.3197      1.137      8
640: 100%|██████████| 20/20 [00:38<00:00, 1.93s/it]
7              Class      Images      Instances      Box(P      R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.60s/it]
8              all      29      29      0.948      0.828
0.876      0.408
9
10     Epoch      GPU_mem      box_loss      cls_loss      dfl_loss      Instances
Size
11     197/200      4.38G      0.4083      0.3256      1.156      8
640: 100%|██████████| 20/20 [00:31<00:00, 1.55s/it]
12              Class      Images      Instances      Box(P      R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.16s/it]
13              all      29      29      0.988      0.862
0.907      0.407
14
15     Epoch      GPU_mem      box_loss      cls_loss      dfl_loss      Instances
Size
16     198/200      4.38G      0.4042      0.3064      1.138      8
640: 100%|██████████| 20/20 [00:32<00:00, 1.64s/it]
17              Class      Images      Instances      Box(P      R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.13s/it]
18              all      29      29      0.992      0.862
0.91      0.424
19
20     Epoch      GPU_mem      box_loss      cls_loss      dfl_loss      Instances
Size
21     199/200      4.38G      0.4241      0.3125      1.163      8
640: 100%|██████████| 20/20 [00:33<00:00, 1.66s/it]
22              Class      Images      Instances      Box(P      R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.29s/it]
23              all      29      29      0.926      0.864
0.91      0.433
24
25     Epoch      GPU_mem      box_loss      cls_loss      dfl_loss      Instances
Size
26     200/200      4.38G      0.4013      0.3003      1.143      8
640: 100%|██████████| 20/20 [00:33<00:00, 1.66s/it]
27              Class      Images      Instances      Box(P      R
mAP50  mAP50-95): 100%|██████████| 1/1 [00:03<00:00, 3.16s/it]
28              all      29      29      0.961      0.856
0.916      0.441
29
30 200 epochs completed in 2.288 hours.
31 Optimizer stripped from /home/ubuntu22/Project/yolo-accident-
detector/runs/detect/train21/weights/last.pt, 4.9MB

```

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32 | Optimizer stripped from /home/ubuntu22/Project/yolo-accident-
    | detector/runs/detect/train21/weights/best.pt, 4.9MB
33 |
34 | validating /home/ubuntu22/Project/yolo-accident-
    | detector/runs/detect/train21/weights/best.pt...
35 | Ultralytics 8.3.114 🚀 Python-3.10.12 torch-2.4.1+cu124 CUDA:0 (NVIDIA
    | GeForce RTX 3050 Laptop GPU, 4096MiB)
36 | YOLO11_GhostConv summary (fused): 107 layers, 2,256,651 parameters, 0
    | gradients
37 |
    | Class      Images  Instances  Box(P      R
    | mAP50  mAP50-95): 100%|██████████| 1/1 [00:00<00:00, 2.63it/s]
38 |
    | all      29      29      0.896      0.888
    | 0.906      0.509
39 | Speed: 0.5ms preprocess, 5.5ms inference, 0.0ms loss, 1.8ms postprocess per
    | image
40 | Results saved to /home/ubuntu22/Project/yolo-accident-
    | detector/runs/detect/train21
```

提升

指标项	无 ATFL (train21)	有 ATFL (train20)	差异
Box(P)	0.896	0.97	↑ 提升了 0.074
Recall (R)	0.888	0.931	↑ 提升了 0.043
mAP@0.5	0.906	0.957	↑ 提升了 0.051
mAP@0.5:0.95	0.509	0.561	↑ 提升了 0.052