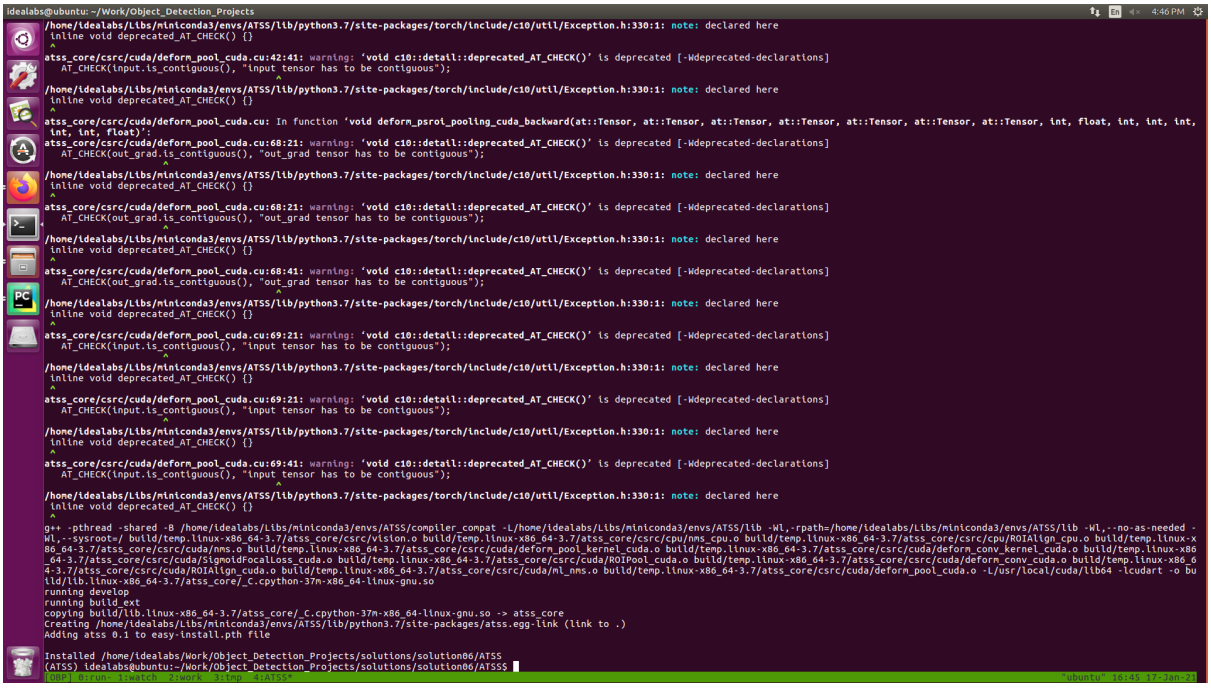
参数解析

```
MODEL:
  META_ARCHITECTURE: "GeneralizedRCNN"
  WEIGHT: "catalog://ImageNetPretrained/MSRA/R-50" # imagenet 预训练模型
  RPN_ONLY: True # ?
  ATSS_ON: True # 使用 Adaptive Training Sample Selection 策略
  BACKBONE:
    CONV_BODY: "R-50-FPN-RETINANET" # backbone + FPN 网络结构
  RESNETS:
    BACKBONE_OUT_CHANNELS: 256
  RETINANET:
    USE_C5: False # ?
  ATSS:
    ANCHOR_SIZES: (64, 128, 256, 512, 1024) # 8S ?
    ASPECT_RATIOS: (1.0,) # ATSS 里面不用配置 anchor 的长宽比
    SCALES_PER_OCTAVE: 1 # ATSS 里面不用配置 anchor 的大小
    USE_DCN_IN_TOWER: False # 是否使用 deformable convolution
    POSITIVE_TYPE: 'ATSS' # how to select positves: ATSS (Ours) , SSC (FCOS),
IoU (RetinaNet)
    TOPK: 9 # 每一层选取的候选 anchor 数量
    REGRESSION_TYPE: 'BOX' # 回归点还是框，ATSS 只是一种 anchor 自动匹配策略，可以适应
两种，BOX是RetinaNet，POINT是FCOS
DATASETS:
  TRAIN: ("coco_2017_train",)
  TEST: ("coco_2017_val",)
INPUT:
  MIN_SIZE_TRAIN: (800,)
  MAX_SIZE_TRAIN: 1333
  MIN_SIZE_TEST: 800
  MAX_SIZE_TEST: 1333
DATALOADER:
  SIZE_DIVISIBILITY: 32
SOLVER:
  BASE_LR: 0.01
  WEIGHT_DECAY: 0.0001
  STEPS: (60000, 80000)
  MAX_ITER: 90000
  IMS_PER_BATCH: 4
  WARMUP_METHOD: "constant"
```

运行demo

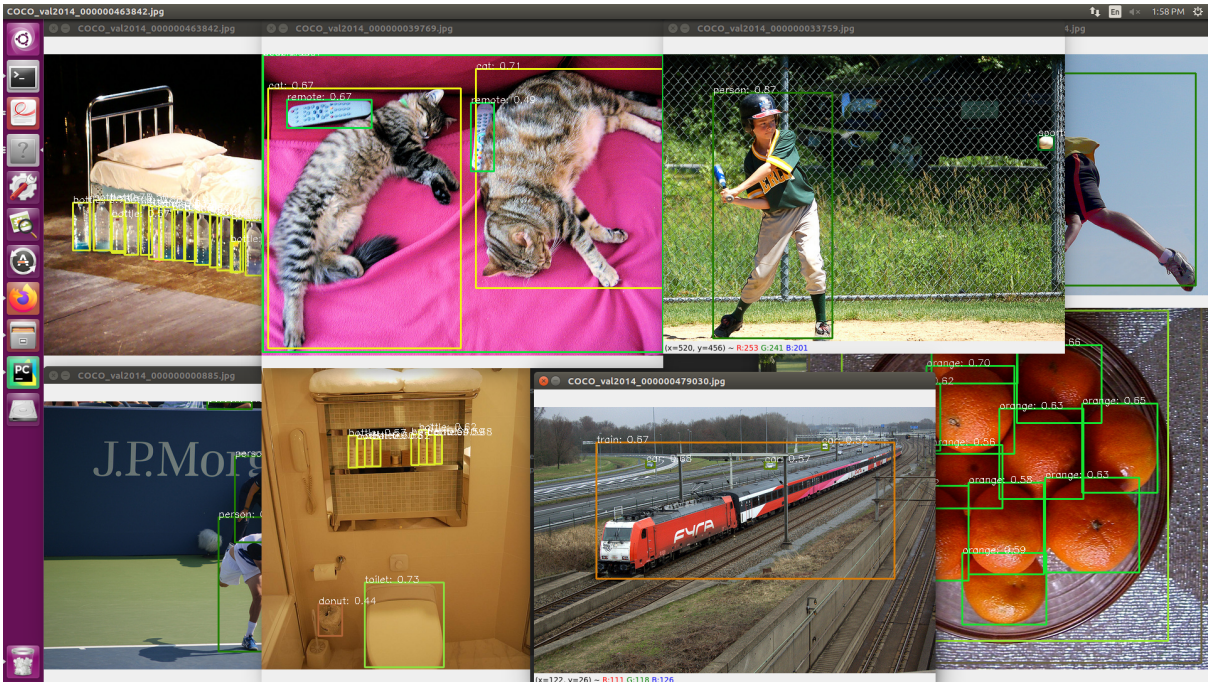
1. 安装

```
conda create -n ATSS python=3.7
conda activate ATSS
conda install ipython
pip install ninja yacs cython matplotlib tqdm
conda install -c pytorch torchvision cudatoolkit=10.0
conda install -c conda-forge pycocotools
git clone https://github.com/sfzhang15/ATSS.git
cd ATSS
python setup.py build develop --no-deps
```



2. 运行 demo

`python demo/atss_demo.py`



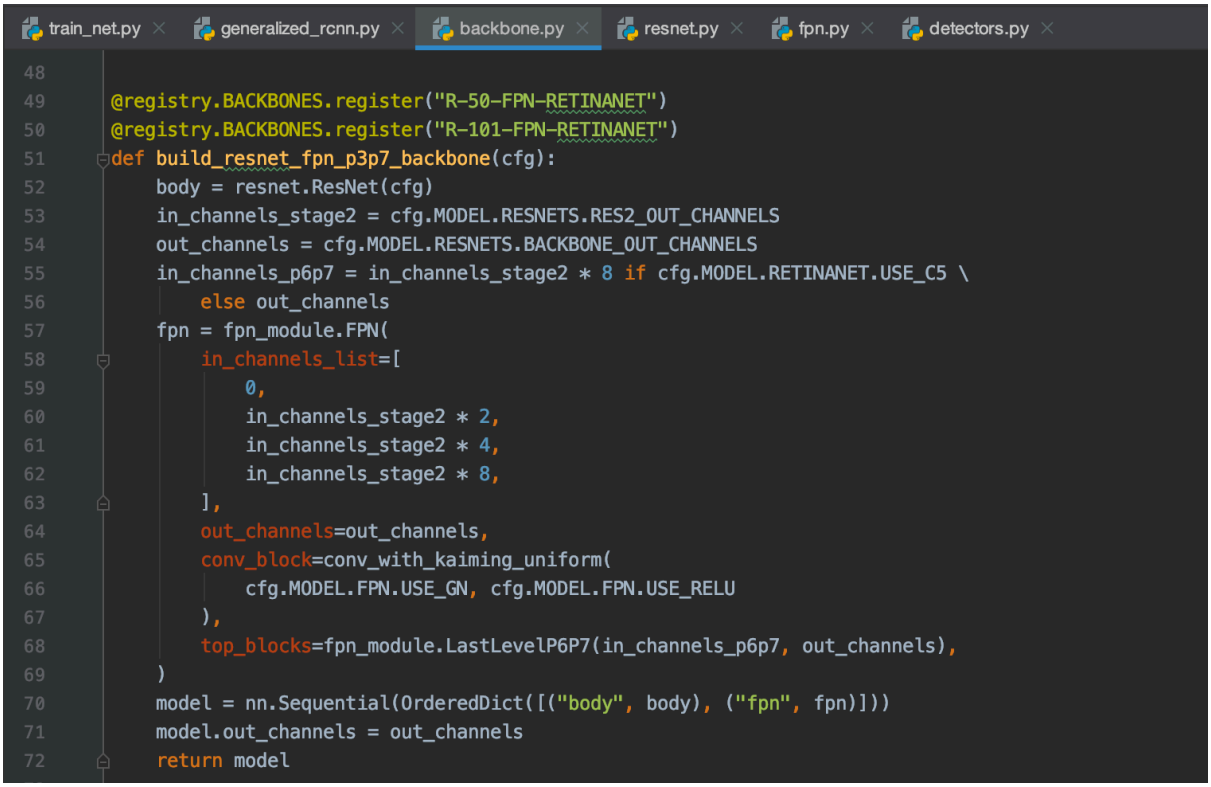
调试

1. 构建模型

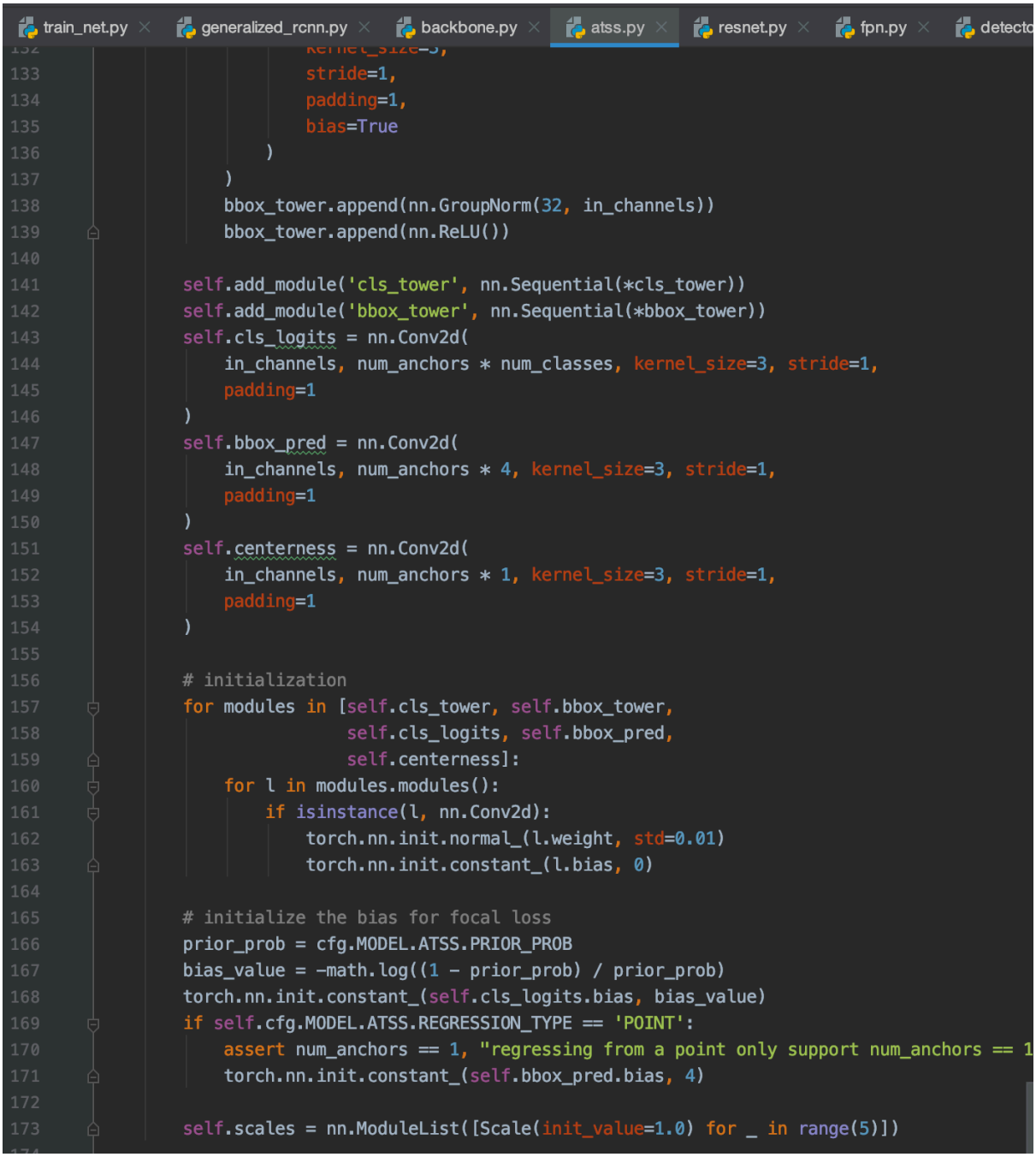
train_net.py detectors.py

```
29
30  def train(cfg, local_rank, distributed):
31      model = build_detection_model(cfg)
32      device = torch.device(cfg.MODEL.DEVICE)
33      model.to(device)
34
35      if cfg.MODEL.USE_SYNCBN:
36          assert is_pytorch_1_1_0_or_later(), \
37              "SyncBatchNorm is only available in pytorch >= 1.1.0"
38          model = torch.nn.SyncBatchNorm.convert_sync_batchnorm(model)
39
40      optimizer = make_optimizer(cfg, model)
41      scheduler = make_lr_scheduler(cfg, optimizer)
42
43      if distributed:
44          model = torch.nn.parallel.DistributedDataParallel(
45              model, device_ids=[local_rank], output_device=local_rank,
46              # this should be removed if we update BatchNorm stats
47              broadcast_buffers=False,
48          )
49
50      arguments = {}
51      arguments["iteration"] = 0
52
53      output_dir = cfg.OUTPUT_DIR
54
55      save_to_disk = get_rank() == 0
56      checkpointer = DetectronCheckpointer(
57          cfg, model, optimizer, scheduler, output_dir, save_to_disk
58      )
59      extra_checkpoint_data = checkpointer.load(cfg.MODEL.WEIGHT)
60      arguments.update(extra_checkpoint_data)
61
62      data_loader = make_data_loader(
63          cfg,
64          is_train=True,
65          is_distributed=distributed,
66          start_iter=arguments["iteration"],
67      )
68
69      checkpoint_period = cfg.SOLVER.CHECKPOINT_PERIOD
```

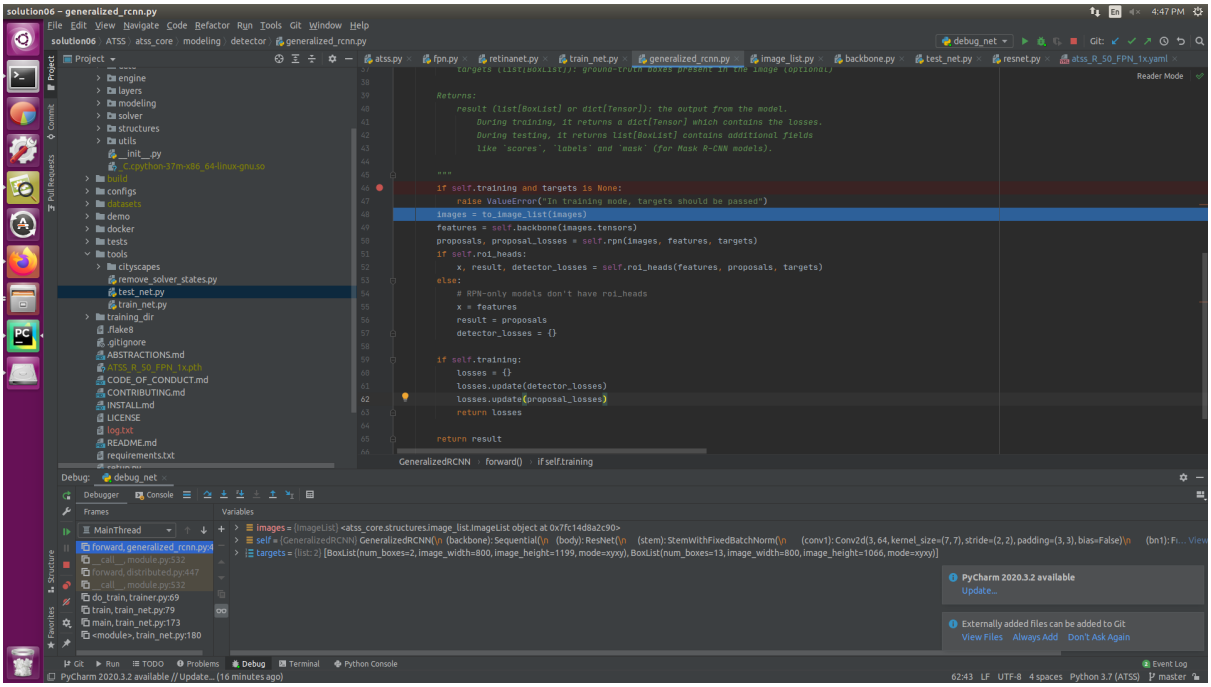
2. 构建 backbone 特征提取器，这里没有区分 backbone 和 neck 所以 resnet和fpn是一起构建的



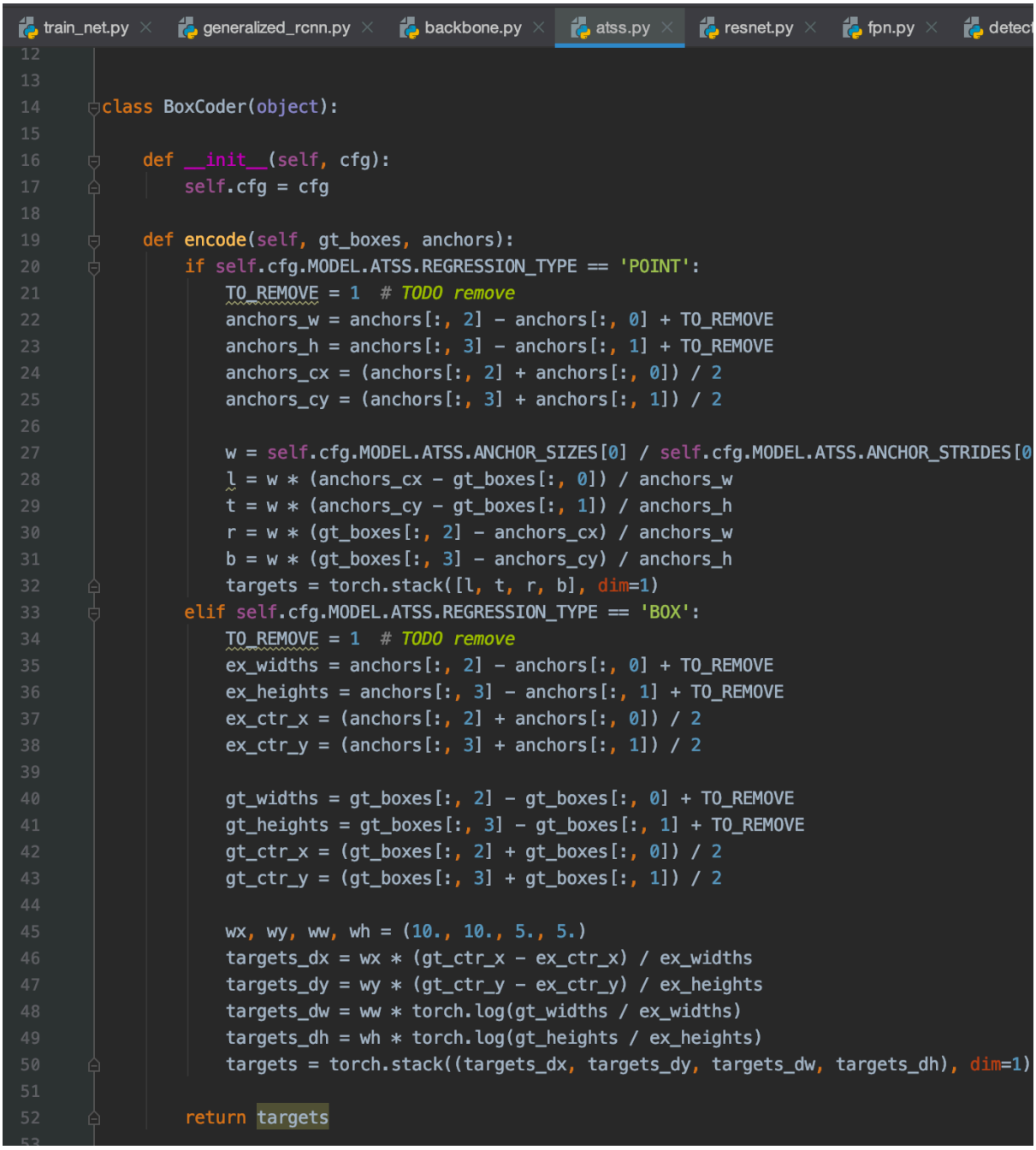
3. 构建 ATSS head 在增强后的特征基础上进行分类和回归，同时增加了centerness分支。至此模型构建完成开始模型训练。



4. generalized_rcnn.py中的forward函数: 这里可以看出大致的运行流程，先将images转换为ImageList，经过backbone提取特征，通过rpn获取proposals和proposal_losses, 这里的rpn就是ATSSModule，因此核心逻辑都在atss.py里面。后面着重分析atss.py和loss.py两个函数。



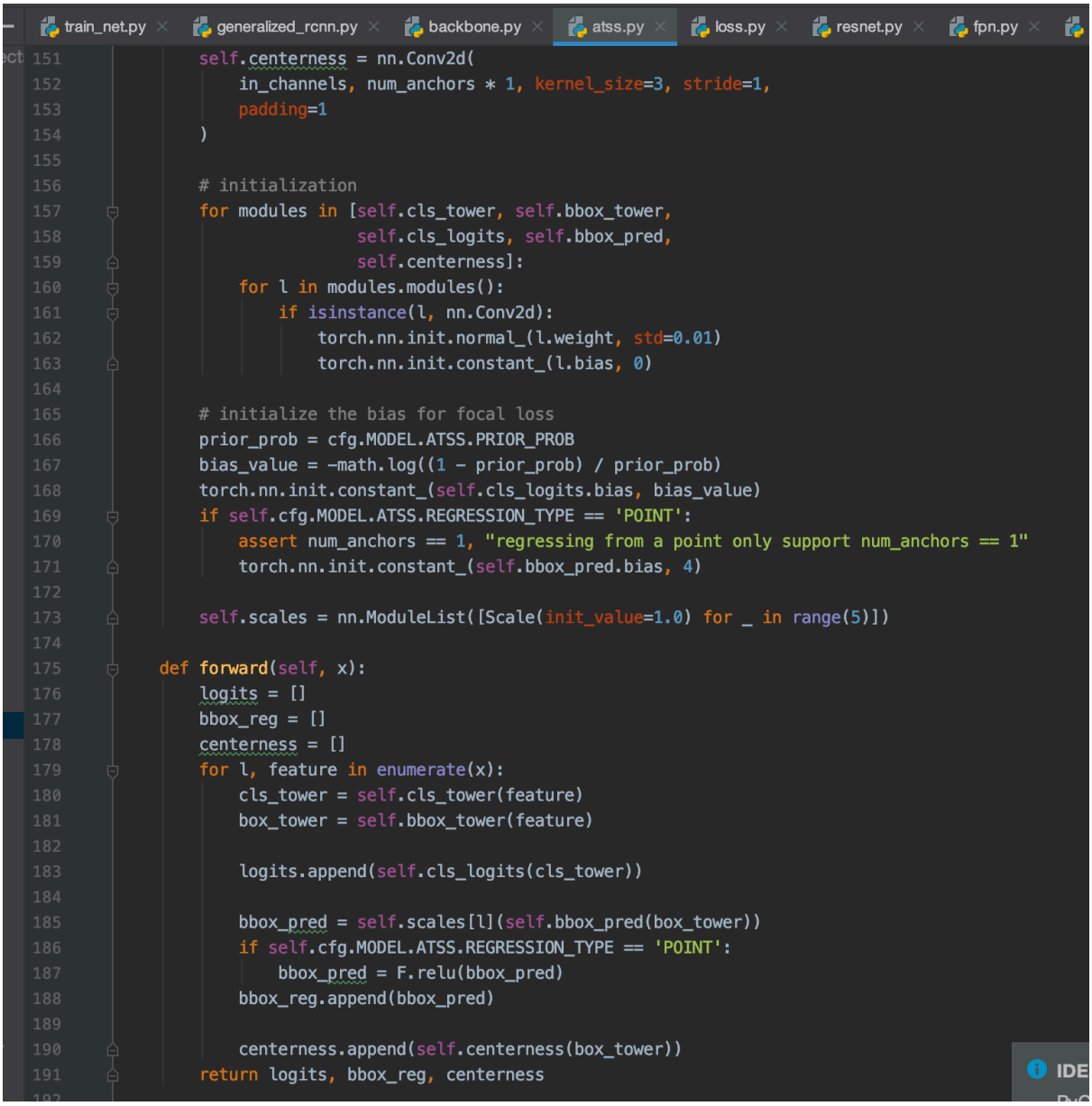
5. atss.py 中 BoxCoder是对训练的目标进行编码，当 `cfg.MODEL.ATSS.REGRESSION_TYPE` 为 `POINT` 的时候，回归的目标是anchor中心点到真实框四条边的距离。同样预测的时候按照相反的规则进行解码



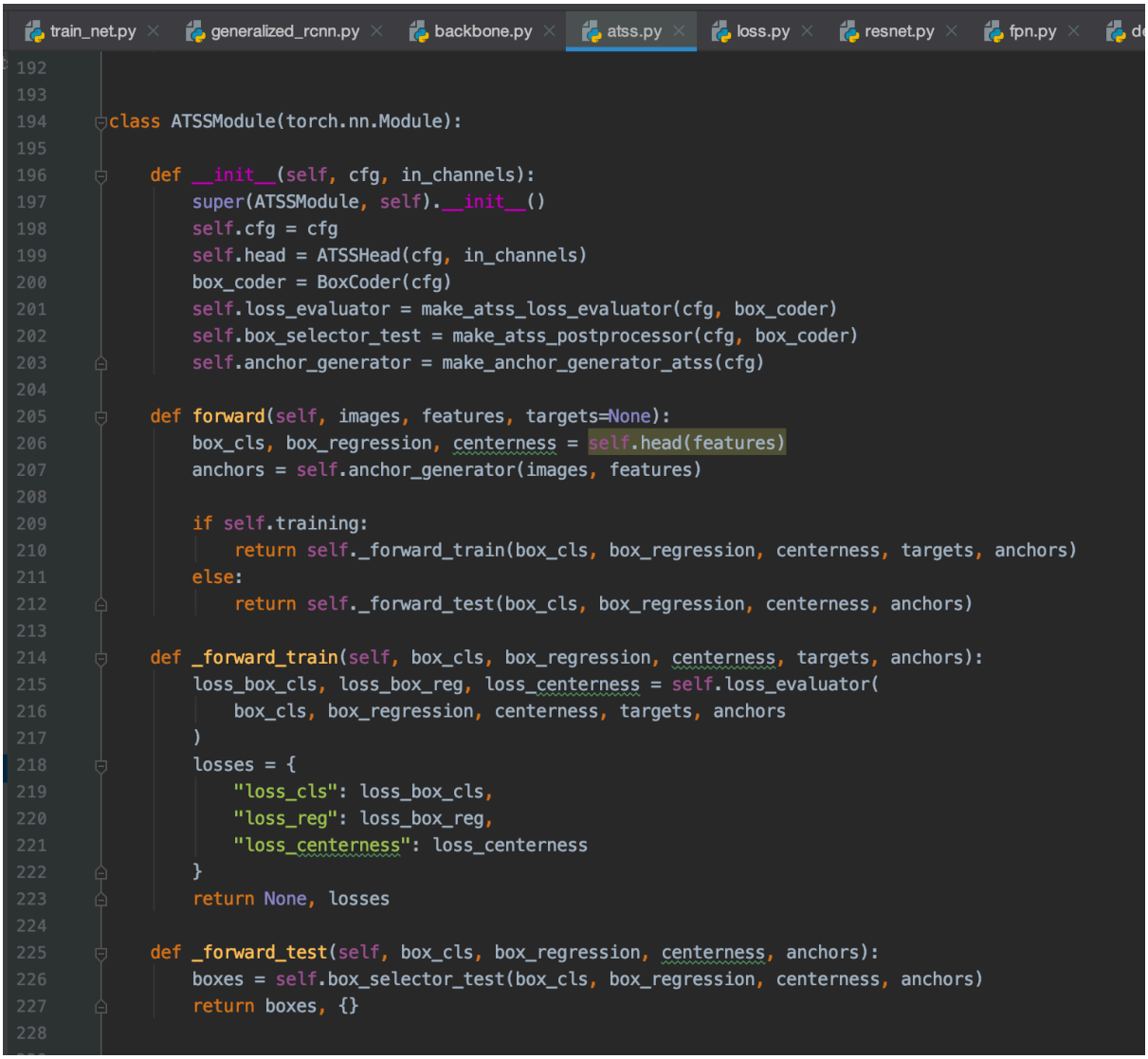
ATSS

接下来主要看看 loss.py 关于 anchor 和 ground truth 的匹配，以及 threshold 计算等核心逻辑都在这里。

1. atss.py 中 ATSSHead 是对 feature pyramid 中的 cell 进行 classification， box_regression 和 centerness prediction



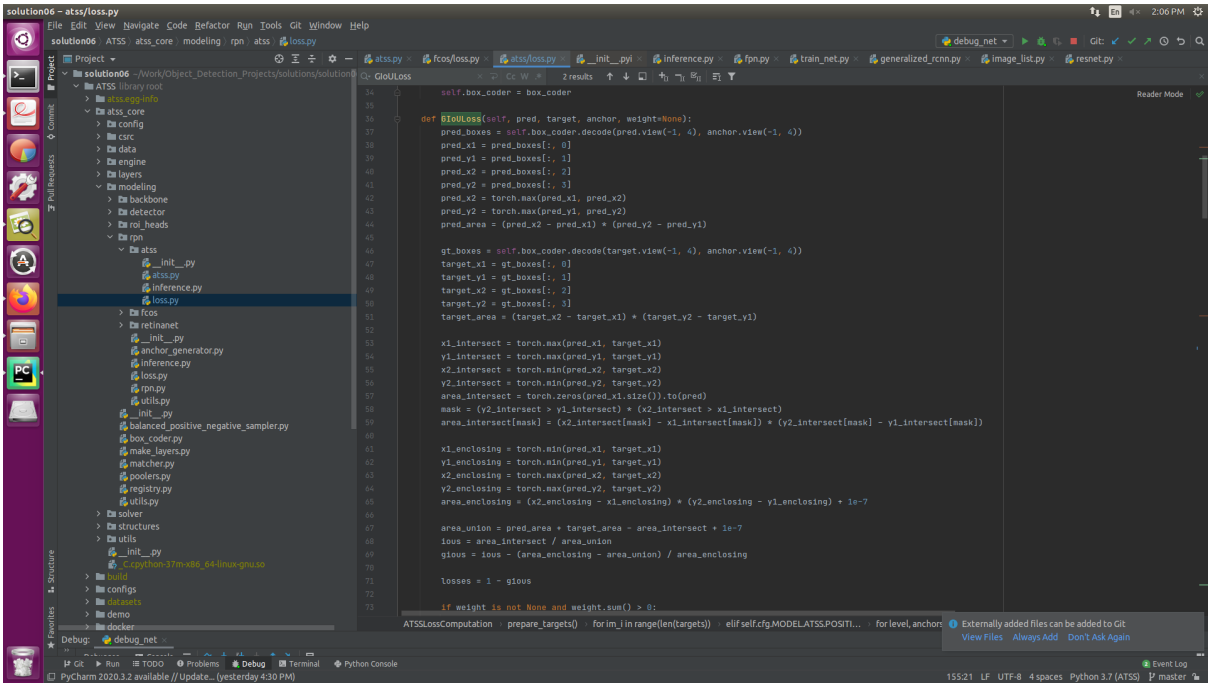
2. atss.py 中 ATSSModule 主要是对 anchor 进行分类和回归同时计算 loss



3. GIoU loss GIoU 是对 IoU 的改进，可以直接用 1 - $GIoU$ 作为 loss 函数来训练模型

   $$GIoU = IoU - \frac{|Ac-U|}{|Ac|}$$

   先计算两个框之间的最小外接矩形面积Ac, 计算两个框的所占的面积U, $Ac - U$ 是最小外接矩形不属于两个框的面积。和IoU相比$GIoU$是更好的距离度量指标，不仅仅关注重叠区域也关注非重叠区域。



4. 先针对每一层计算每个 anchor 到 ground truth 中心点距离，然后根据距离排序选出 topk 候选 anchor

```
elif self.cfg.MODEL.ATSS.POSITIVE_TYPE == 'ATSS':
    num_anchors_per_loc = len(self.cfg.MODEL.ATSS.ASPECT_RATIOS) * self.cfg.MODEL.ATSS.SCALES_PER_OCTAVE

    num_anchors_per_level = [len(anchors_per_level.bbox) for anchors_per_level in anchors[im_i]]
    ious = boxlist_iou(anchors_per_im, targets_per_im)

    gt_cx = (bboxes_per_im[:, 2] + bboxes_per_im[:, 0]) / 2.0
    gt_cy = (bboxes_per_im[:, 3] + bboxes_per_im[:, 1]) / 2.0
    gt_points = torch.stack((gt_cx, gt_cy), dim=1)

    anchors_cx_per_im = (anchors_per_im.bbox[:, 2] + anchors_per_im.bbox[:, 0]) / 2.0
    anchors_cy_per_im = (anchors_per_im.bbox[:, 3] + anchors_per_im.bbox[:, 1]) / 2.0
    anchor_points = torch.stack((anchors_cx_per_im, anchors_cy_per_im), dim=1)

    distances = (anchor_points[:, None, :] - gt_points[None, :, :]).pow(2).sum(-1).sqrt()

    # Selecting candidates based on the center distance between anchor box and object
    candidate_idxs = []
    star_idx = 0
    for level, anchors_per_level in enumerate(anchors[im_i]):
        end_idx = star_idx + num_anchors_per_level[level]
        distances_per_level = distances[star_idx:end_idx, :]
        topk = min(self.cfg.MODEL.ATSS.TOPK * num_anchors_per_loc, num_anchors_per_level[level])
        _, topk_idxs_per_level = distances_per_level.topk(topk, dim=0, largest=False)
        candidate_idxs.append(topk_idxs_per_level + star_idx)
        star_idx = end_idx
    candidate_idxs = torch.cat(candidate_idxs, dim=0)
```

5. 计算 ground truth 和 候选 anchor. 之间的 IoU, 计算这些候选 anchor IOU 的均值和标准差，筛选该 ground truth 的候选 anchor 的 IoU 阈值时 mean + std

```
# Using the sum of mean and standard deviation as the IoU threshold to select final positive samples
candidate_ious = ious[candidate_idxs, torch.arange(num_gt)]
iou_mean_per_gt = candidate_ious.mean(0)
iou_std_per_gt = candidate_ious.std(0)
iou_thresh_per_gt = iou_mean_per_gt + iou_std_per_gt
is_pos = candidate_ious >= iou_thresh_per_gt[None, :]
```

6. 使用该 IoU 阈值筛选 anchor 同时保证 anchor 中心在 ground truth 里面

```
# Limiting the final positive samples' center to object
anchor_num = anchors_cx_per_im.shape[0]
for ng in range(num_gt):
    candidate_idxs[:, ng] += ng * anchor_num
e_anchors_cx = anchors_cx_per_im.view(1, -1).expand(num_gt, anchor_num).contiguous().view(-1)
e_anchors_cy = anchors_cy_per_im.view(1, -1).expand(num_gt, anchor_num).contiguous().view(-1)
candidate_idxs = candidate_idxs.view(-1)
l = e_anchors_cx[candidate_idxs].view(-1, num_gt) - bboxes_per_im[:, 0]
t = e_anchors_cy[candidate_idxs].view(-1, num_gt) - bboxes_per_im[:, 1]
r = bboxes_per_im[:, 2] - e_anchors_cx[candidate_idxs].view(-1, num_gt)
b = bboxes_per_im[:, 3] - e_anchors_cy[candidate_idxs].view(-1, num_gt)
is_in_gts = torch.stack([l, t, r, b], dim=1).min(dim=1)[0] > 0.01
is_pos = is_pos & is_in_gts

# if an anchor box is assigned to multiple gts, the one with the highest IoU will be selected.
ious_inf = torch.full_like(ious, -INF).t().contiguous().view(-1)
index = candidate_idxs.view(-1)[is_pos.view(-1)]
ious_inf[index] = ious.t().contiguous().view(-1)[index]
ious_inf = ious_inf.view(num_gt, -1).t()
```

问题

1. PyCharm debug torch.distributed.launch debug 的时候报错，可以正常运行

   `python -m torch.distributed.launch` 实际运行的是另外一个torch库脚本，路径不在当前工程里面。修改 script path 可以正常调试。