Code Result

Step 1: Object Masking:

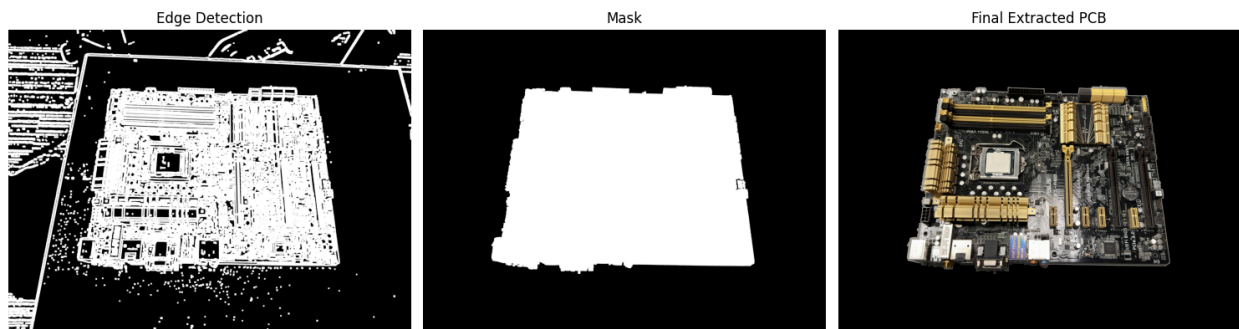| Edge Detection | Mask | Final Extracted PCB |

Installation Process:

Collecting ultralytics
  Downloading ultralytics-8.3.39-py3-none-any.whl.metadata (35 kB)
Requirement already satisfied: numpy>=1.23.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (1.26.4)
Requirement already satisfied: matplotlib>=3.3.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (3.8.0)
Requirement already satisfied: opencv-python>=4.6.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (4.10.0.84)
Requirement already satisfied: pillow>=7.1.2 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (11.0.0)
Requirement already satisfied: pyyaml>=5.3.1 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (6.0.2)
Requirement already satisfied: requests>=2.23.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (2.32.3)
Requirement already satisfied: scipy>=1.4.1 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (1.13.1)
Requirement already satisfied: torch>=1.8.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (2.5.1+cu121)
Requirement already satisfied: torchvision>=0.9.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (0.20.1+cu121)
Requirement already satisfied: tqdm>=4.64.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (4.66.6)
Requirement already satisfied: psutil in /usr/local/lib/python3.10/dist-packages (from ultralytics) (5.9.5)
Requirement already satisfied: py-cpuinfo in /usr/local/lib/python3.10/dist-packages (from ultralytics) (9.0.0)
Requirement already satisfied: pandas>=1.1.4 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (2.2.2)

Requirement already satisfied: seaborn>=0.11.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (0.13.2)

Collecting ultralytics-thop>=2.0.0 (from ultralytics)

  Downloading ultralytics_thop-2.0.12-py3-none-any.whl.metadata (9.4 kB)

Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (1.3.1)

Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (0.12.1)

Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (4.55.0)

Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (1.4.7)

Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (24.2)

Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (3.2.0)

Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (2.8.2)

Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.1.4->ultralytics) (2024.2)

Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.1.4->ultralytics) (2024.2)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (3.4.0)

Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (3.10)

Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (2.2.3)

Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (2024.8.30)

Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (3.16.1)

Requirement already satisfied: typing-extensions>=4.8.0 in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (4.12.2)

Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (3.4.2)

Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (3.1.4)

Requirement already satisfied: fsspec in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (2024.10.0)

Requirement already satisfied: sympy==1.13.1 in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (1.13.1)

Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy==1.13.1->torch>=1.8.0->ultralytics) (1.3.0)

Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.7->matplotlib>=3.3.0->ultralytics) (1.16.0)

Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from jinja2->torch>=1.8.0->ultralytics) (3.0.2)

Downloading ultralytics-8.3.39-py3-none-any.whl (896 kB)

━━━━━━━━━━━━━━━━━━━━━━━━━ 896.9/896.9 kB

35.6 MB/s eta 0:00:00

Downloading ultralytics_thop-2.0.12-py3-none-any.whl (26 kB)

Installing collected packages: ultralytics-thop, ultralytics

Successfully installed ultralytics-8.3.39 ultralytics-thop-2.0.12

Step 2: YOLOv8 Training:

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.
Downloading https://github.com/ultralytics/assets/releases/download/v8.3.0/yolov8n.pt to 'yolov8n.pt'...

100%|████████████| 6.25M/6.25M [00:00<00:00, 173MB/s]

Ultralytics 8.3.39 🚀 Python-3.10.12 torch-2.5.1+cu121 CUDA:0 (Tesla T4, 15102MiB)
engine/trainer: task=detect, mode=train, model=yolov8n.pt, data=/content/drive/MyDrive/aer850_project3/data/data.yaml, epochs=170, time=None, patience=100, batch=2, imgsz=1024, save=True, save_period=-1, cache=False, device=None, workers=8, project=None, name=pcb_identifier, exist_ok=False, pretrained=True, optimizer=auto, verbose=True, seed=0, deterministic=True, single_cls=False, rect=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profile=False, freeze=None, multi_scale=False, overlap_mask=True, mask_ratio=4, dropout=0.0, val=True, split=val, save_json=False, save_hybrid=False, conf=None, iou=0.7, max_det=300, half=False, dnn=False, plots=True, source=None, vid_stride=1, stream_buffer=False, visualize=False, augment=False, agnostic_nms=False, classes=None, retina_masks=False, embed=None, show=False, save_frames=False, save_txt=False, save_conf=False, save_crop=False, show_labels=True, show_conf=True, show_boxes=True, line_width=None, format=torchscript, keras=False, optimize=False, int8=False, dynamic=False,

simplify=True, opset=None, workspace=None, nms=False, lr0=0.01, lrf=0.01, momentum=0.937, weight_decay=0.0005, warmup_epochs=3.0, warmup_momentum=0.8, warmup_bias_lr=0.1, 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, fliplr=0.5, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, copy_paste_mode=flip, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.yaml, save_dir=runs/detect/pcb_identifier
Downloading https://ultralytics.com/assets/Arial.ttf to '/root/.config/Ultralytics/Arial.ttf'...

100%|██████████| 755k/755k [00:00<00:00, 32.3MB/s]

Overriding model.yaml nc=80 with nc=13

	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]
15	-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	753847	ultralytics.nn.modules.head.Detect	[13, [64, 128, 256]]

Model summary: 225 layers, 3,013,383 parameters, 3,013,367 gradients, 8.2 GFLOPs

Transferred 319/355 items from pretrained weights
TensorBoard: Start with 'tensorboard --logdir runs/detect/pcb_identifier', 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, 150MB/s]

AMP: checks passed ✅

train: Scanning /content/drive/MyDrive/aer850_project3/data/train/labels... 544 images, 0 backgrounds, 0 corrupt: 100%|███████████| 544/544 [04:50<00:00, 1.87it/s]

train: New cache created: /content/drive/MyDrive/aer850_project3/data/train/labels.cache
WARNING ⚠️ Box and segment counts should be equal, but got len(segments) = 26, len(boxes) = 108783. To resolve this only boxes will be used and all segments will be removed. To avoid this please supply either a detect or segment dataset, not a detect-segment mixed dataset.
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01, blur_limit=(3, 7)), ToGray(p=0.01, num_output_channels=3, method='weighted_average'), CLAHE(p=0.01, clip_limit=(1.0, 4.0), tile_grid_size=(8, 8))

/usr/local/lib/python3.10/dist-packages/albumentations/__init__.py:24: UserWarning: A new version of Albumentations is available: 1.4.21 (you have 1.4.20). Upgrade using: pip install -U albumentations. To disable automatic update checks, set the environment variable NO_ALBUMENTATIONS_UPDATE to 1.
  check_for_updates()
val: Scanning /content/drive/MyDrive/aer850_project3/data/valid/labels... 105 images, 0 backgrounds, 0 corrupt: 100%|███████████| 105/105 [00:55<00:00, 1.90it/s]
val: New cache created: /content/drive/MyDrive/aer850_project3/data/valid/labels.cache
WARNING ⚠️ Box and segment counts should be equal, but got len(segments) = 26, len(boxes) = 19108. To resolve this only boxes will be used and all segments will be removed. To avoid this please supply either a detect or segment dataset, not a detect-segment mixed dataset.

Plotting labels to runs/detect/pcb_identifier/labels.jpg...
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and determining best 'optimizer', 'lr0' and 'momentum' automatically...
optimizer: AdamW(lr=0.000588, momentum=0.9) with parameter groups 57 weight(decay=0.0), 64 weight(decay=0.0005), 63 bias(decay=0.0)
TensorBoard: model graph visualization added ✅
Image sizes 1024 train, 1024 val
Using 2 dataloader workers
Logging results to **runs/detect/pcb_identifier**
Starting training for 170 epochs...

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      1/170     3.68G      2.289      4.013      1.276        874       1024: 100%|███████████| 272/272
[00:58<00:00,  4.64it/s]
              Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|███████████|
27/27 [00:10<00:00,  2.49it/s]

                all        105      19108      0.764     0.0724      0.065     0.0355

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
    2/170      6.57G     2.297     2.993     1.161       537      1024: 100%|███████████| 272/272
[00:55<00:00,  4.91it/s]
          Class    Images  Instances      Box(P          R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:04<00:00,  5.64it/s]
            all       105     19108     0.632     0.108    0.0855    0.0457


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    3/170      4.98G     2.242     2.618     1.139       714      1024: 100%|███████████| 272/272
[00:55<00:00,  4.89it/s]
          Class    Images  Instances      Box(P          R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:06<00:00,  4.16it/s]

            all       105     19108     0.488     0.127     0.109    0.0592


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    4/170      5.04G     2.186     2.424     1.116       590      1024: 100%|███████████| 272/272
[00:55<00:00,  4.94it/s]
          Class    Images  Instances      Box(P          R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:07<00:00,  3.53it/s]

            all       105     19108     0.435     0.148      0.16     0.104


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    5/170      4.24G     2.135     2.352     1.112      1236      1024: 100%|███████████| 272/272
[00:54<00:00,  4.98it/s]
          Class    Images  Instances      Box(P          R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:06<00:00,  4.42it/s]
            all       105     19108     0.422     0.188     0.158    0.0933


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    6/170      5.88G     2.099     2.181     1.101      1278      1024: 100%|███████████| 272/272
[00:54<00:00,  4.98it/s]
          Class    Images  Instances      Box(P          R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:09<00:00,  2.71it/s]
            all       105     19108     0.118     0.275      0.15    0.0889


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    7/170      4.23G     2.089     2.153     1.103       762      1024: 100%|███████████| 272/272
[00:55<00:00,  4.93it/s]
          Class    Images  Instances      Box(P          R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:06<00:00,  4.10it/s]
```

```
                 all        105      19108      0.391      0.259      0.173      0.103

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      8/170     3.78G      2.051      2.089      1.089        491     1024: 100%|████████████| 272/272
[00:54<00:00,  4.97it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:09<00:00,  2.70it/s]
                 all        105      19108      0.337      0.247      0.189      0.116

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      9/170     4.62G      2.015      2.034      1.075        408     1024: 100%|████████████| 272/272
[00:54<00:00,  4.97it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:06<00:00,  4.21it/s]
                 all        105      19108      0.381      0.267      0.215      0.134

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     10/170     6.67G      1.999      1.965      1.064       1569     1024: 100%|████████████| 272/272
[00:54<00:00,  4.96it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:08<00:00,  3.09it/s]
                 all        105      19108      0.486       0.26      0.222      0.135

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     11/170      3.7G      1.992       1.92      1.064        400     1024: 100%|████████████| 272/272
[00:55<00:00,  4.88it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:06<00:00,  4.06it/s]
                 all        105      19108      0.531      0.287      0.254      0.162

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     12/170     4.75G      1.974      1.908      1.062        492     1024: 100%|████████████| 272/272
[00:55<00:00,  4.93it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:09<00:00,  2.73it/s]
                 all        105      19108      0.581      0.303      0.269       0.17

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     13/170     4.66G      1.956       1.88      1.066        681     1024: 100%|████████████| 272/272
[00:54<00:00,  5.01it/s]
```

```
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  4.49it/s]
                   all        105      19108      0.576      0.302      0.285      0.178

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    14/170      3.88G      1.932      1.835      1.053        485      1024: 100%|          | 272/272
[00:55<00:00,  4.93it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  4.46it/s]
                   all        105      19108      0.642      0.266      0.284      0.179

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    15/170      6.37G      1.916      1.826      1.047        674      1024: 100%|          | 272/272
[00:54<00:00,  4.96it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|          |
27/27 [00:09<00:00,  2.85it/s]
                   all        105      19108      0.558      0.327      0.309      0.204

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    16/170      6.07G      1.904      1.784      1.051        459      1024: 100%|          | 272/272
[00:55<00:00,  4.92it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  4.18it/s]
                   all        105      19108      0.544      0.353      0.314      0.203

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    17/170         5G        1.9      1.776      1.044        766      1024: 100%|          | 272/272
[00:55<00:00,  4.93it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|          |
27/27 [00:08<00:00,  3.12it/s]
                   all        105      19108       0.59       0.37      0.331      0.217

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    18/170      5.44G      1.914      1.732      1.037        635      1024: 100%|          | 272/272
[00:55<00:00,  4.87it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  4.14it/s]
                   all        105      19108      0.559      0.354       0.35      0.224

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size
```

```
    19/170     4.51G    1.901    1.731    1.041       369      1024: 100%|███████████| 272/272
[00:54<00:00,  5.02it/s]
              Class   Images Instances     Box(P         R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:06<00:00,  3.94it/s]

                all      105    19108    0.641    0.355    0.361     0.24

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss   Instances       Size

    20/170     3.36G    1.919    1.712    1.048       680      1024: 100%|███████████| 272/272
[00:55<00:00,  4.89it/s]
              Class   Images Instances     Box(P         R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:06<00:00,  3.89it/s]
                all      105    19108    0.544    0.368    0.368    0.244

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss   Instances       Size

    21/170     4.46G    1.846    1.672    1.023       686      1024: 100%|███████████| 272/272
[00:55<00:00,  4.89it/s]
              Class   Images Instances     Box(P         R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:05<00:00,  5.18it/s]
                all      105    19108     0.56     0.37    0.383    0.253

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss   Instances       Size

    22/170     8.02G    1.865     1.64    1.039       414      1024: 100%|███████████| 272/272
[00:54<00:00,  4.97it/s]
              Class   Images Instances     Box(P         R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:08<00:00,  3.13it/s]
                all      105    19108    0.593    0.353    0.387    0.257

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss   Instances       Size

    23/170     5.36G    1.861    1.638    1.031       821      1024: 100%|███████████| 272/272
[00:54<00:00,  4.99it/s]
              Class   Images Instances     Box(P         R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:05<00:00,  4.72it/s]
                all      105    19108    0.654    0.358    0.388    0.257

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss   Instances       Size

    24/170       5G    1.828    1.612    1.027       540      1024: 100%|███████████| 272/272
[00:54<00:00,  5.02it/s]
              Class   Images Instances     Box(P         R    mAP50  mAP50-95): 100%|███████████|
27/27 [00:06<00:00,  3.96it/s]
```

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                 all        105      19108      0.431       0.38      0.376      0.252

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      25/170     4.65G      1.856      1.609      1.022        808      1024: 100%|████████| 272/272
[00:55<00:00,  4.89it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:06<00:00,  4.09it/s]
                 all        105      19108      0.664      0.345      0.405      0.269

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      26/170      6.2G      1.841      1.613      1.027        247      1024: 100%|████████| 272/272
[00:54<00:00,  4.98it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:05<00:00,  4.99it/s]
                 all        105      19108      0.435      0.397      0.405      0.274

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      27/170     4.44G      1.825       1.57      1.017        491      1024: 100%|████████| 272/272
[00:54<00:00,  4.96it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:08<00:00,  3.11it/s]
                 all        105      19108      0.527       0.39      0.421       0.28

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      28/170      5.3G      1.802      1.552      1.022        500      1024: 100%|████████| 272/272
[00:56<00:00,  4.85it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:04<00:00,  5.61it/s]
                 all        105      19108       0.49      0.421      0.418      0.276

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      29/170     4.28G      1.818      1.573      1.019        921      1024: 100%|████████| 272/272
[00:55<00:00,  4.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:06<00:00,  3.93it/s]
                 all        105      19108      0.446      0.401      0.411      0.274

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      30/170     5.38G      1.782      1.534      1.016        449      1024: 100%|████████| 272/272
[00:55<00:00,  4.94it/s]
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                Class     Images Instances     Box(P         R      mAP50 mAP50-95): 100%|          |
27/27 [00:07<00:00,  3.43it/s]
                  all        105      19108       0.625      0.371      0.418      0.272

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss Instances       Size

    31/170      6.07G      1.787      1.546       1.01        623      1024: 100%|          | 272/272
[00:55<00:00,  4.89it/s]
                Class     Images Instances     Box(P         R      mAP50 mAP50-95): 100%|          |
27/27 [00:05<00:00,  5.23it/s]
                  all        105      19108       0.522      0.407      0.451      0.303

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss Instances       Size

    32/170      4.59G       1.82      1.516      1.015        381      1024: 100%|          | 272/272
[00:54<00:00,  4.98it/s]
                Class     Images Instances     Box(P         R      mAP50 mAP50-95): 100%|          |
27/27 [00:08<00:00,  3.35it/s]
                  all        105      19108       0.417       0.49      0.448      0.299

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss Instances       Size

    33/170      4.63G      1.753      1.472      1.008        678      1024: 100%|          | 272/272
[00:53<00:00,  5.07it/s]
                Class     Images Instances     Box(P         R      mAP50 mAP50-95): 100%|          |
27/27 [00:06<00:00,  4.44it/s]
                  all        105      19108       0.474      0.461      0.458      0.304

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss Instances       Size

    34/170      5.21G      1.768       1.49      1.009        220      1024: 100%|          | 272/272
[00:54<00:00,  4.96it/s]
                Class     Images Instances     Box(P         R      mAP50 mAP50-95): 100%|          |
27/27 [00:05<00:00,  5.18it/s]
                  all        105      19108       0.593       0.39      0.441      0.286

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss Instances       Size

    35/170      3.93G       1.77      1.496      1.001        157      1024: 100%|          | 272/272
[00:54<00:00,  4.98it/s]
                Class     Images Instances     Box(P         R      mAP50 mAP50-95): 100%|          |
27/27 [00:07<00:00,  3.68it/s]

                  all        105      19108       0.507      0.476      0.476      0.318

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss Instances       Size
```

```
      36/170      5.75G      1.776      1.468      1.007       515      1024: 100%|██████████| 272/272
[00:54<00:00,  4.97it/s]
                Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.91it/s]
                  all       105      19108      0.461      0.495      0.485       0.32


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      37/170      5.06G      1.774      1.452     0.9991       877      1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
                Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  5.41it/s]
                  all       105      19108      0.557       0.48      0.495      0.332


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      38/170      3.63G      1.734      1.443     0.9978       713      1024: 100%|██████████| 272/272
[00:54<00:00,  4.96it/s]
                Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.60it/s]
                  all       105      19108      0.498      0.498      0.502      0.341


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      39/170      5.78G      1.764      1.463      1.002       749      1024: 100%|██████████| 272/272
[00:55<00:00,  4.91it/s]
                Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  5.31it/s]
                  all       105      19108      0.552      0.515      0.527      0.356


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      40/170      5.74G      1.773      1.443      1.003       379      1024: 100%|██████████| 272/272
[00:54<00:00,  4.96it/s]
                Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.95it/s]

                  all       105      19108       0.52      0.507      0.502      0.345


    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      41/170      5.37G      1.742      1.421      1.001      1014      1024: 100%|██████████| 272/272
[00:54<00:00,  5.01it/s]
                Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.49it/s]
```

```
                all        105      19108      0.534      0.456      0.474      0.314

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      42/170     4.13G      1.743      1.398     0.9972        336       1024: 100%|████████████| 272/272
[00:54<00:00,  5.00it/s]
              Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:04<00:00,  5.69it/s]
                all        105      19108      0.527      0.522       0.52      0.356

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      43/170     4.42G      1.742      1.412     0.9977        284       1024: 100%|████████████| 272/272
[00:55<00:00,  4.90it/s]
              Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:05<00:00,  5.17it/s]
                all        105      19108      0.551      0.506      0.531      0.362

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      44/170     6.34G      1.704      1.368     0.9921        355       1024: 100%|████████████| 272/272
[00:55<00:00,  4.92it/s]
              Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:07<00:00,  3.78it/s]
                all        105      19108      0.583      0.511      0.535      0.367

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      45/170     5.48G      1.704      1.372     0.9881        291       1024: 100%|████████████| 272/272
[00:55<00:00,  4.93it/s]
              Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:04<00:00,  5.66it/s]
                all        105      19108      0.542      0.522       0.53      0.362

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      46/170     4.65G      1.723      1.369     0.9947        701       1024: 100%|████████████| 272/272
[00:54<00:00,  5.03it/s]
              Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:05<00:00,  4.85it/s]

                all        105      19108      0.551      0.525      0.533      0.348

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
   47/170     4.47G     1.702     1.357     0.9844      1231      1024: 100%|██████████| 272/272 [00:54<00:00, 4.96it/s]
            Class    Images Instances     Box(P         R     mAP50  mAP50-95): 100%|██████████| 27/27 [00:07<00:00, 3.59it/s]
              all       105     19108     0.593     0.496      0.51     0.341

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   48/170      3.9G     1.696     1.349     0.9847       454      1024: 100%|██████████| 272/272 [00:54<00:00, 4.99it/s]
            Class    Images Instances     Box(P         R     mAP50  mAP50-95): 100%|██████████| 27/27 [00:04<00:00, 5.70it/s]
              all       105     19108     0.561     0.553     0.561     0.383

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   49/170     6.32G     1.707     1.344     0.9849       517      1024: 100%|██████████| 272/272 [00:55<00:00, 4.94it/s]
            Class    Images Instances     Box(P         R     mAP50  mAP50-95): 100%|██████████| 27/27 [00:05<00:00, 5.23it/s]
              all       105     19108     0.599     0.527     0.557     0.383

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   50/170     4.16G     1.715     1.352     0.9897       332      1024: 100%|██████████| 272/272 [00:54<00:00, 5.03it/s]
            Class    Images Instances     Box(P         R     mAP50  mAP50-95): 100%|██████████| 27/27 [00:07<00:00, 3.60it/s]
              all       105     19108     0.623     0.526     0.545     0.379

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   51/170     4.24G     1.698      1.33     0.9855       658      1024: 100%|██████████| 272/272 [00:55<00:00, 4.92it/s]
            Class    Images Instances     Box(P         R     mAP50  mAP50-95): 100%|██████████| 27/27 [00:04<00:00, 5.59it/s]
              all       105     19108     0.579     0.555     0.562     0.382

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   52/170      5.3G     1.711     1.317     0.9829       206      1024: 100%|██████████| 272/272 [00:55<00:00, 4.88it/s]
            Class    Images Instances     Box(P         R     mAP50  mAP50-95): 100%|██████████| 27/27 [00:04<00:00, 5.42it/s]

              all       105     19108     0.579     0.528     0.552     0.362
```

```
     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
     53/170     6.03G     1.709     1.324    0.9861        630     1024: 100%|███████████| 272/272 [00:54<00:00,  4.95it/s]
             Class    Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|███████████| 27/27 [00:07<00:00,  3.76it/s]
               all       105     19108      0.614     0.496     0.545     0.366

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
     54/170     5.08G     1.691     1.301    0.9745        931     1024: 100%|███████████| 272/272 [00:55<00:00,  4.86it/s]
             Class    Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|███████████| 27/27 [00:04<00:00,  5.84it/s]
               all       105     19108       0.62      0.54     0.569     0.389

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
     55/170     4.95G     1.647      1.28    0.9748        339     1024: 100%|███████████| 272/272 [00:54<00:00,  4.98it/s]
             Class    Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|███████████| 27/27 [00:05<00:00,  5.36it/s]
               all       105     19108      0.684     0.533     0.581     0.393

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
     56/170     4.08G     1.683     1.304    0.9795        147     1024: 100%|███████████| 272/272 [00:54<00:00,  4.95it/s]
             Class    Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|███████████| 27/27 [00:06<00:00,  3.97it/s]
               all       105     19108      0.587     0.561     0.569      0.38

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
     57/170     4.82G     1.655     1.276    0.9804        322     1024: 100%|███████████| 272/272 [00:54<00:00,  4.99it/s]
             Class    Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|███████████| 27/27 [00:04<00:00,  5.75it/s]
               all       105     19108      0.621     0.559     0.583     0.401

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
     58/170     5.78G     1.687     1.278    0.9786        598     1024: 100%|███████████| 272/272 [00:54<00:00,  5.01it/s]
```

```
              Class     Images  Instances     Box(P        R     mAP50  mAP50-95): 100%|████████████|
27/27 [00:05<00:00,  4.66it/s]
                all        105     19108      0.609     0.563     0.577     0.397

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    59/170     5.38G      1.648       1.25     0.9681        746      1024: 100%|██████████| 272/272
[00:54<00:00,  5.01it/s]
              Class     Images  Instances     Box(P        R     mAP50  mAP50-95): 100%|████████████|
27/27 [00:06<00:00,  3.94it/s]
                all        105     19108      0.656     0.574     0.607     0.413

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    60/170     4.81G      1.636      1.265      0.975        656      1024: 100%|██████████| 272/272
[00:54<00:00,  4.95it/s]
              Class     Images  Instances     Box(P        R     mAP50  mAP50-95): 100%|████████████|
27/27 [00:04<00:00,  5.88it/s]
                all        105     19108      0.607     0.575     0.603     0.413

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    61/170     5.06G      1.694      1.278     0.9782        816      1024: 100%|█████████| 272/272
[00:55<00:00,  4.91it/s]
              Class     Images  Instances     Box(P        R     mAP50  mAP50-95): 100%|████████████|
27/27 [00:05<00:00,  4.81it/s]

                all        105     19108      0.617     0.576     0.595     0.402

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    62/170     4.43G      1.647      1.246     0.9688        600      1024: 100%|█████████| 272/272
[00:55<00:00,  4.94it/s]
              Class     Images  Instances     Box(P        R     mAP50  mAP50-95): 100%|████████████|
27/27 [00:07<00:00,  3.86it/s]
                all        105     19108      0.683     0.553        0.6     0.414

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

    63/170     4.55G      1.643      1.244     0.9734        757      1024: 100%|█████████| 272/272
[00:56<00:00,  4.83it/s]
              Class     Images  Instances     Box(P        R     mAP50  mAP50-95): 100%|████████████|
27/27 [00:04<00:00,  5.78it/s]
                all        105     19108      0.654     0.562     0.608     0.417

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
   64/170      6.76G      1.655      1.239     0.9708        778       1024: 100%|          | 272/272
[00:55<00:00,  4.88it/s]
             Class     Images Instances      Box(P        R    mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  4.44it/s]
               all        105      19108      0.694      0.539      0.597        0.4

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   65/170      6.06G       1.64      1.234     0.9701        265       1024: 100%|          | 272/272
[00:54<00:00,  4.98it/s]
             Class     Images Instances      Box(P        R    mAP50  mAP50-95): 100%|          |
27/27 [00:05<00:00,  4.72it/s]
               all        105      19108      0.653      0.581      0.624      0.432

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   66/170         6G      1.681      1.257     0.9803        666       1024: 100%|          | 272/272
[00:54<00:00,  4.97it/s]
             Class     Images Instances      Box(P        R    mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00,  5.83it/s]
               all        105      19108      0.679      0.567       0.62      0.428

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   67/170      3.24G      1.654      1.221     0.9731        697       1024: 100%|          | 272/272
[00:54<00:00,  4.95it/s]
             Class     Images Instances      Box(P        R    mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  3.99it/s]

               all        105      19108      0.672       0.57      0.614      0.417

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   68/170       5.4G      1.666      1.244      0.972        446       1024: 100%|          | 272/272
[00:54<00:00,  5.00it/s]
             Class     Images Instances      Box(P        R    mAP50  mAP50-95): 100%|          |
27/27 [00:05<00:00,  4.74it/s]
               all        105      19108      0.677      0.589      0.628      0.436

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   69/170       3.9G      1.636      1.224      0.965        271       1024: 100%|          | 272/272
[00:55<00:00,  4.89it/s]
             Class     Images Instances      Box(P        R    mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00,  5.88it/s]
```

```
                 all         105        19108       0.668       0.596        0.62       0.431

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

      70/170     5.83G       1.641      1.207      0.9643        366       1024: 100%|██████████| 272/272
[00:55<00:00,  4.92it/s]
               Class      Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  4.11it/s]

                 all         105        19108       0.697       0.597       0.632       0.432

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

      71/170     4.58G       1.623      1.196      0.9602        731       1024: 100%|██████████| 272/272
[00:54<00:00,  4.99it/s]
               Class      Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  4.40it/s]
                 all         105        19108       0.683       0.595       0.633       0.441

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

      72/170     5.25G        1.63      1.195      0.9689        732       1024: 100%|██████████| 272/272
[00:55<00:00,  4.93it/s]
               Class      Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  5.86it/s]
                 all         105        19108       0.706       0.585       0.634       0.428

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

      73/170     4.24G       1.616      1.195      0.9678        685       1024: 100%|██████████| 272/272
[00:55<00:00,  4.92it/s]
               Class      Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.75it/s]

                 all         105        19108       0.697       0.585       0.622       0.433

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

      74/170     4.29G       1.608      1.187      0.9625        445       1024: 100%|██████████| 272/272
[00:54<00:00,  4.95it/s]
               Class      Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.82it/s]
                 all         105        19108       0.699       0.572       0.631       0.437

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size
```

```
    75/170     7.73G     1.604     1.172     0.9687      482       1024: 100%|████████████| 272/272
[00:54<00:00, 4.98it/s]
           Class    Images Instances     Box(P        R     mAP50 mAP50-95): 100%|████████|
27/27 [00:04<00:00, 5.70it/s]
             all       105     19108     0.717     0.576      0.63     0.434


   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss Instances      Size

    76/170     4.98G     1.611     1.169     0.9649      180       1024: 100%|████████████| 272/272
[00:54<00:00, 4.96it/s]
           Class    Images Instances     Box(P        R     mAP50 mAP50-95): 100%|████████|
27/27 [00:05<00:00, 5.11it/s]

             all       105     19108     0.677     0.606     0.633      0.44


   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss Instances      Size

    77/170     5.98G     1.611     1.179     0.9665      815       1024: 100%|████████████| 272/272
[00:54<00:00, 5.01it/s]
           Class    Images Instances     Box(P        R     mAP50 mAP50-95): 100%|████████|
27/27 [00:07<00:00, 3.61it/s]

             all       105     19108     0.714     0.594      0.64     0.445


   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss Instances      Size

    78/170     4.34G     1.596     1.169     0.9603      728       1024: 100%|████████████| 272/272
[00:54<00:00, 4.95it/s]
           Class    Images Instances     Box(P        R     mAP50 mAP50-95): 100%|████████|
27/27 [00:04<00:00, 5.76it/s]
             all       105     19108     0.691     0.599      0.64     0.438


   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss Instances      Size

    79/170     4.99G     1.615     1.173     0.9647      133       1024: 100%|████████████| 272/272
[00:54<00:00, 4.98it/s]
           Class    Images Instances     Box(P        R     mAP50 mAP50-95): 100%|████████|
27/27 [00:04<00:00, 5.72it/s]
             all       105     19108     0.744     0.577     0.653     0.454


   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss Instances      Size

    80/170     4.01G     1.599     1.163     0.9552      485       1024: 100%|████████████| 272/272
[00:55<00:00, 4.94it/s]
           Class    Images Instances     Box(P        R     mAP50 mAP50-95): 100%|████████|
27/27 [00:07<00:00, 3.67it/s]
```

```
                all        105      19108      0.702      0.605      0.645       0.45

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      81/170      2.55G      1.583      1.149     0.9552        634       1024: 100%|███████| 272/272
[00:55<00:00,  4.94it/s]
                Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|███████|
27/27 [00:04<00:00,  5.86it/s]
                all        105      19108      0.733        0.6      0.658      0.456

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      82/170      5.11G      1.605      1.158     0.9559        553       1024: 100%|███████| 272/272
[00:56<00:00,  4.86it/s]
                Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|███████|
27/27 [00:04<00:00,  6.01it/s]
                all        105      19108      0.698      0.604      0.644      0.453

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      83/170      3.98G      1.586      1.144     0.9589        608       1024: 100%|███████| 272/272
[00:53<00:00,  5.04it/s]
                Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|███████|
27/27 [00:07<00:00,  3.64it/s]
                all        105      19108      0.686      0.597      0.645      0.445

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      84/170      5.11G      1.609      1.166     0.9693        991       1024: 100%|███████| 272/272
[00:55<00:00,  4.92it/s]
                Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|███████|
27/27 [00:04<00:00,  5.56it/s]
                all        105      19108      0.729      0.616      0.668      0.469

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      85/170       5.1G      1.613      1.138       0.96        764       1024: 100%|███████| 272/272
[00:55<00:00,  4.91it/s]
                Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|███████|
27/27 [00:04<00:00,  5.93it/s]
                all        105      19108      0.703      0.612      0.651      0.445

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

      86/170      5.08G      1.581      1.124     0.9534        244       1024: 100%|███████| 272/272
[00:54<00:00,  4.99it/s]
```

```
                 Class     Images  Instances      Box(P          R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  3.86it/s]
                   all        105      19108       0.73      0.589      0.661      0.451

      Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     87/170     5.26G      1.596      1.131     0.9511        767       1024: 100%|██████████| 272/272
[00:55<00:00,  4.94it/s]
                 Class     Images  Instances      Box(P          R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.16it/s]
                   all        105      19108      0.684      0.629      0.674      0.473

      Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     88/170     6.89G      1.601      1.145     0.9538        188       1024: 100%|██████████| 272/272
[00:54<00:00,  4.96it/s]
                 Class     Images  Instances      Box(P          R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.14it/s]
                   all        105      19108      0.745      0.613      0.672      0.467

      Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     89/170      4.1G      1.582      1.134     0.9519        434       1024: 100%|██████████| 272/272
[00:55<00:00,  4.94it/s]
                 Class     Images  Instances      Box(P          R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.67it/s]
                   all        105      19108      0.702      0.637      0.668      0.466

      Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     90/170     5.36G      1.594      1.134     0.9472        922       1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
                 Class     Images  Instances      Box(P          R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.11it/s]
                   all        105      19108       0.73      0.627      0.671      0.471

      Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     91/170     4.99G       1.61      1.136     0.9529        802       1024: 100%|██████████| 272/272
[00:56<00:00,  4.85it/s]
                 Class     Images  Instances      Box(P          R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  5.84it/s]

                   all        105      19108      0.727      0.617      0.668      0.472

      Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
    92/170    2.84G    1.566    1.119    0.9584      756     1024: 100%|██████████| 272/272
[00:55<00:00,  4.92it/s]
            Class    Images Instances    Box(P       R    mAP50 mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.74it/s]
              all       105    19108    0.759    0.602    0.674    0.467


    Epoch   GPU_mem  box_loss  cls_loss  dfl_loss Instances      Size

    93/170    5.44G    1.577    1.119    0.9497      403     1024: 100%|██████████| 272/272
[00:56<00:00,  4.85it/s]
            Class    Images Instances    Box(P       R    mAP50 mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  5.90it/s]
              all       105    19108    0.768      0.6    0.669    0.468


    Epoch   GPU_mem  box_loss  cls_loss  dfl_loss Instances      Size

    94/170    4.15G    1.561    1.115    0.9457     1006     1024: 100%|██████████| 272/272
[00:55<00:00,  4.94it/s]
            Class    Images Instances    Box(P       R    mAP50 mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.06it/s]
              all       105    19108    0.747    0.615    0.674    0.474


    Epoch   GPU_mem  box_loss  cls_loss  dfl_loss Instances      Size

    95/170    5.18G    1.554    1.104    0.9497      452     1024: 100%|██████████| 272/272
[00:55<00:00,  4.87it/s]
            Class    Images Instances    Box(P       R    mAP50 mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.72it/s]
              all       105    19108    0.765    0.599    0.671    0.475


    Epoch   GPU_mem  box_loss  cls_loss  dfl_loss Instances      Size

    96/170    5.48G    1.571    1.104    0.9548      462     1024: 100%|██████████| 272/272
[00:55<00:00,  4.91it/s]
            Class    Images Instances    Box(P       R    mAP50 mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.06it/s]
              all       105    19108     0.73    0.626    0.678    0.469


    Epoch   GPU_mem  box_loss  cls_loss  dfl_loss Instances      Size

    97/170     7.1G    1.595    1.119    0.9566      337     1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
            Class    Images Instances    Box(P       R    mAP50 mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.07it/s]
              all       105    19108    0.761    0.623    0.679     0.48
```

```
     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size
     98/170     7.5G     1.555     1.095     0.9465      466      1024: 100%|          | 272/272
[00:54<00:00, 4.97it/s]
           Class    Images  Instances       Box(P       R     mAP50  mAP50-95): 100%|          |
27/27 [00:07<00:00, 3.64it/s]
             all      105     19108     0.729     0.645     0.686     0.487

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size
     99/170    3.79G     1.571      1.11     0.9515      308      1024: 100%|          | 272/272
[00:54<00:00, 4.96it/s]
           Class    Images  Instances       Box(P       R     mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00, 5.99it/s]
             all      105     19108     0.744     0.639     0.683     0.476

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size
    100/170    4.97G     1.554     1.087     0.9414      215      1024: 100%|          | 272/272
[00:55<00:00, 4.94it/s]
           Class    Images  Instances       Box(P       R     mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00, 5.92it/s]
             all      105     19108     0.765     0.626     0.688     0.487

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size
    101/170    4.07G     1.566     1.094     0.9493      507      1024: 100%|          | 272/272
[00:55<00:00, 4.92it/s]
           Class    Images  Instances       Box(P       R     mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00, 4.00it/s]
             all      105     19108     0.739      0.63      0.69     0.485

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size
    102/170    5.14G     1.552     1.085     0.9487      238      1024: 100%|          | 272/272
[00:54<00:00, 4.97it/s]
           Class    Images  Instances       Box(P       R     mAP50  mAP50-95): 100%|          |
27/27 [00:05<00:00, 5.33it/s]
             all      105     19108     0.734     0.633     0.688     0.485

     Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size
```

```
   103/170      6.27G      1.544      1.079      0.9461       672      1024: 100%|██████████| 272/272
[00:55<00:00,  4.87it/s]
             Class     Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.03it/s]
               all        105      19108      0.756      0.641      0.686      0.482

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   104/170      5.67G      1.527      1.059      0.9437       847      1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
             Class     Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  3.99it/s]

               all        105      19108      0.773      0.635      0.691       0.49

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   105/170      3.88G      1.544       1.08      0.9424       322      1024: 100%|██████████| 272/272
[00:55<00:00,  4.89it/s]
             Class     Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  5.97it/s]
               all        105      19108      0.722       0.65      0.693       0.49

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   106/170      6.18G      1.553      1.076      0.9409      1159      1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
             Class     Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.15it/s]
               all        105      19108      0.741      0.639      0.688      0.484

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   107/170      6.26G      1.557      1.079      0.946       725      1024: 100%|██████████| 272/272
[00:55<00:00,  4.91it/s]
             Class     Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  4.05it/s]

               all        105      19108      0.763       0.63      0.684      0.481

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   108/170      4.68G      1.541      1.081      0.9443       370      1024: 100%|██████████| 272/272
[00:54<00:00,  4.99it/s]
             Class     Images  Instances      Box(P         R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.71it/s]
```
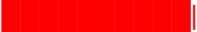
```
                all        105      19108      0.773       0.64      0.702      0.501

     Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   109/170     5.24G      1.516      1.057     0.9475        275      1024: 100%|████████| 272/272
[00:55<00:00,  4.91it/s]
              Class      Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:04<00:00,  5.95it/s]
                all        105      19108      0.759      0.634        0.7      0.491

     Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   110/170      6.9G      1.541      1.063     0.9436        309      1024: 100%|████████| 272/272
[00:56<00:00,  4.85it/s]
              Class      Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:06<00:00,  4.33it/s]

                all        105      19108      0.779      0.644      0.698      0.496

     Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   111/170     4.58G      1.542       1.06     0.9383        210      1024: 100%|████████| 272/272
[00:55<00:00,  4.94it/s]
              Class      Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:05<00:00,  4.60it/s]
                all        105      19108      0.748      0.644        0.7      0.487

     Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   112/170     4.67G      1.552      1.076     0.9464        675      1024: 100%|████████| 272/272
[00:56<00:00,  4.80it/s]
              Class      Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:04<00:00,  6.02it/s]
                all        105      19108      0.761      0.645      0.706      0.492

     Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   113/170     4.89G      1.551      1.069     0.9398        807      1024: 100%|████████| 272/272
[00:56<00:00,  4.84it/s]
              Class      Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:05<00:00,  5.23it/s]

                all        105      19108      0.778      0.634      0.701      0.494

     Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
  114/170      7.17G      1.535      1.068      0.9467        129        1024: 100%|██████████| 272/272
[00:54<00:00,  5.00it/s]
            Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.72it/s]
              all        105      19108      0.742      0.651      0.705      0.492

    Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

  115/170      5.66G       1.51      1.044      0.9375        512        1024: 100%|██████████| 272/272
[00:56<00:00,  4.84it/s]
            Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.09it/s]
              all        105      19108      0.753      0.656      0.702      0.493

    Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

  116/170      5.29G      1.511      1.052      0.9385        290        1024: 100%|██████████| 272/272
[00:55<00:00,  4.88it/s]
            Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.12it/s]
              all        105      19108      0.753      0.648      0.704      0.496

    Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

  117/170      5.69G      1.525      1.042      0.9347        299        1024: 100%|██████████| 272/272
[00:55<00:00,  4.88it/s]
            Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.60it/s]

              all        105      19108      0.769      0.638      0.701      0.498

    Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

  118/170      5.48G       1.52      1.052      0.9338        153        1024: 100%|██████████| 272/272
[00:55<00:00,  4.92it/s]
            Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  5.80it/s]
              all        105      19108       0.78      0.641      0.706      0.501

    Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

  119/170      6.01G      1.537      1.055      0.9408        366        1024: 100%|██████████| 272/272
[00:54<00:00,  4.96it/s]
            Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.02it/s]
              all        105      19108      0.773      0.648      0.708      0.502
```

```
     Epoch   GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   120/170     5.1G     1.532     1.052    0.9412       327      1024: 100%|██████████| 272/272 [00:55<00:00,  4.89it/s]
           Class    Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 27/27 [00:07<00:00,  3.71it/s]
             all      105     19108      0.759      0.648      0.707      0.501

     Epoch   GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   121/170    5.49G     1.524     1.045    0.9396       870      1024: 100%|██████████| 272/272 [00:55<00:00,  4.92it/s]
           Class    Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 27/27 [00:04<00:00,  5.87it/s]
             all      105     19108      0.776      0.643      0.712      0.509

     Epoch   GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   122/170    3.82G     1.544     1.054    0.9408       383      1024: 100%|██████████| 272/272 [00:55<00:00,  4.94it/s]
           Class    Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 27/27 [00:04<00:00,  6.12it/s]
             all      105     19108      0.756      0.667      0.713      0.506

     Epoch   GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   123/170    4.41G     1.504     1.034    0.9367       419      1024: 100%|██████████| 272/272 [00:55<00:00,  4.86it/s]
           Class    Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 27/27 [00:07<00:00,  3.65it/s]
             all      105     19108      0.774      0.662      0.719      0.507

     Epoch   GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   124/170    4.38G     1.519     1.034     0.932       714      1024: 100%|██████████| 272/272 [00:55<00:00,  4.87it/s]
           Class    Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 27/27 [00:04<00:00,  6.22it/s]
             all      105     19108      0.768      0.654      0.712      0.503

     Epoch   GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
```

```
   125/170     5.23G     1.514     1.025     0.9368       550      1024: 100%|██████████| 272/272
[00:56<00:00,  4.84it/s]
            Class    Images Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.00it/s]
              all       105     19108     0.761     0.655     0.716     0.507

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   126/170     6.87G     1.529     1.032     0.9305       656      1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
            Class    Images Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.51it/s]
              all       105     19108      0.77     0.654     0.715     0.509

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   127/170     3.99G     1.519     1.027     0.9318       490      1024: 100%|██████████| 272/272
[00:55<00:00,  4.87it/s]
            Class    Images Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  5.56it/s]
              all       105     19108     0.738     0.658      0.71     0.505

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   128/170     4.75G     1.523     1.035     0.9331       919      1024: 100%|██████████| 272/272
[00:55<00:00,  4.88it/s]
            Class    Images Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.10it/s]
              all       105     19108     0.774     0.646     0.709     0.506

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   129/170     4.53G     1.516     1.019     0.933       899      1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
            Class    Images Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  4.45it/s]
              all       105     19108     0.789     0.633     0.713     0.512

   Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

   130/170     5.8G      1.506     1.028     0.9349       539      1024: 100%|██████████| 272/272
[00:56<00:00,  4.85it/s]
            Class    Images Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.69it/s]
              all       105     19108     0.786     0.643      0.71     0.509
```

```
    Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   131/170    4.87G     1.499     1.03     0.9366      692       1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
            Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.11it/s]
             all       105    19108     0.769     0.65     0.709     0.512

    Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   132/170    3.87G     1.519     1.037     0.935      683       1024: 100%|██████████| 272/272
[00:55<00:00,  4.86it/s]
            Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  4.47it/s]

             all       105    19108     0.794     0.649     0.712     0.512

    Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   133/170    4.83G     1.504     1.018     0.9321     591       1024: 100%|██████████| 272/272
[00:55<00:00,  4.90it/s]
            Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  4.28it/s]
             all       105    19108     0.809     0.647     0.718     0.51

    Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   134/170    4.09G     1.498     1.015     0.93      225       1024: 100%|██████████| 272/272
[00:56<00:00,  4.84it/s]
            Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.11it/s]
             all       105    19108     0.771     0.661     0.712     0.505

    Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   135/170    4.33G     1.486     1.01     0.9253     156       1024: 100%|██████████| 272/272
[00:54<00:00,  4.99it/s]
            Class    Images  Instances      Box(P        R     mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.72it/s]

             all       105    19108     0.783     0.654     0.715     0.508

    Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
   136/170    5.01G     1.501     1.013     0.934     333       1024: 100%|██████████| 272/272
[00:55<00:00,  4.93it/s]
```

```
                Class     Images  Instances     Box(P          R     mAP50  mAP50-95): 100%|            |
27/27 [00:05<00:00,  4.71it/s]
                  all        105      19108      0.773      0.658      0.719      0.511

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     137/170      4.43G      1.503      1.013     0.9318        955     1024: 100%|            | 272/272
[00:55<00:00,  4.91it/s]
                Class     Images  Instances     Box(P          R     mAP50  mAP50-95): 100%|            |
27/27 [00:04<00:00,  6.03it/s]
                  all        105      19108      0.782       0.65      0.719      0.515

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     138/170       4.2G      1.505      1.019     0.9323        671     1024: 100%|            | 272/272
[00:54<00:00,  4.96it/s]
                Class     Images  Instances     Box(P          R     mAP50  mAP50-95): 100%|            |
27/27 [00:06<00:00,  4.01it/s]
                  all        105      19108      0.803      0.648      0.721      0.518

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     139/170      4.17G      1.507       1.02     0.9316        684     1024: 100%|            | 272/272
[00:55<00:00,  4.90it/s]
                Class     Images  Instances     Box(P          R     mAP50  mAP50-95): 100%|            |
27/27 [00:04<00:00,  6.18it/s]
                  all        105      19108      0.787      0.653      0.717      0.511

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     140/170      3.08G      1.487     0.9998     0.9283        404     1024: 100%|            | 272/272
[00:56<00:00,  4.82it/s]
                Class     Images  Instances     Box(P          R     mAP50  mAP50-95): 100%|            |
27/27 [00:04<00:00,  6.08it/s]
                  all        105      19108      0.765      0.675      0.722      0.515

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

     141/170      5.42G      1.496      1.008     0.9322        887     1024: 100%|            | 272/272
[00:55<00:00,  4.91it/s]
                Class     Images  Instances     Box(P          R     mAP50  mAP50-95): 100%|            |
27/27 [00:07<00:00,  3.79it/s]
                  all        105      19108      0.789      0.668      0.725      0.516

       Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
   142/170      4.92G      1.474     0.9847     0.9277       1007       1024: 100%|████████████| 272/272
[00:55<00:00,  4.89it/s]
              Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.12it/s]
                 all        105      19108      0.808      0.665      0.732      0.526

     Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

   143/170      5.35G      1.461     0.9931     0.9297        668       1024: 100%|████████████| 272/272
[00:55<00:00,  4.86it/s]
              Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.21it/s]
                 all        105      19108      0.787      0.671      0.727      0.522

     Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

   144/170      4.16G      1.489     0.9934     0.9336        612       1024: 100%|████████████| 272/272
[00:55<00:00,  4.86it/s]
              Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:06<00:00,  4.18it/s]

                 all        105      19108      0.813      0.665      0.725      0.523

     Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

   145/170      4.21G      1.501      1.011     0.9376        411       1024: 100%|████████████| 272/272
[00:55<00:00,  4.88it/s]
              Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:05<00:00,  4.90it/s]
                 all        105      19108      0.824      0.653      0.726      0.521

     Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

   146/170       3.3G      1.485      1.002     0.9277        808       1024: 100%|████████████| 272/272
[00:54<00:00,  4.95it/s]
              Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:04<00:00,  6.08it/s]
                 all        105      19108      0.794      0.672       0.73      0.524

     Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

   147/170      3.54G      1.483     0.9945     0.9232        975       1024: 100%|████████████| 272/272
[00:55<00:00,  4.94it/s]
              Class     Images  Instances       Box(P          R      mAP50  mAP50-95): 100%|██████████|
27/27 [00:07<00:00,  3.82it/s]
```

```
                  all        105      19108      0.809      0.661       0.73      0.525

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    148/170     5.94G      1.497     0.9991     0.9318        832       1024: 100%|████████████| 272/272
[00:55<00:00,  4.91it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:04<00:00,  6.11it/s]
                  all        105      19108       0.81      0.668      0.731       0.53

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    149/170     4.97G       1.47     0.9783     0.9279        517       1024: 100%|████████████| 272/272
[00:55<00:00,  4.87it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:04<00:00,  6.14it/s]
                  all        105      19108      0.806       0.66      0.727      0.524

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    150/170     4.21G      1.497     0.9957     0.9286        560       1024: 100%|████████████| 272/272
[00:56<00:00,  4.77it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:06<00:00,  4.18it/s]
                  all        105      19108      0.797      0.656      0.727      0.524

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    151/170     5.35G      1.489     0.9951     0.9242        408       1024: 100%|████████████| 272/272
[00:55<00:00,  4.89it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:05<00:00,  4.54it/s]
                  all        105      19108       0.78      0.673      0.728      0.525

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size

    152/170     4.34G      1.474     0.9901     0.9276        837       1024: 100%|████████████| 272/272
[00:55<00:00,  4.94it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████████|
27/27 [00:04<00:00,  5.99it/s]
                  all        105      19108      0.796      0.665      0.728      0.523

      Epoch    GPU_mem    box_loss   cls_loss   dfl_loss  Instances       Size
```

```
     153/170     5.16G     1.456     0.9878     0.9261       274       1024: 100%|          | 272/272
[00:56<00:00,  4.82it/s]
             Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          |
27/27 [00:05<00:00,  5.13it/s]
               all       105      19108      0.814     0.662      0.731      0.524

    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

     154/170     4.59G     1.434     0.9728     0.9241       349       1024: 100%|          | 272/272
[00:55<00:00,  4.92it/s]
             Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  3.99it/s]
               all       105      19108      0.773     0.676      0.733      0.528

    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

     155/170      4.4G     1.478     0.9788     0.9283        67       1024: 100%|          | 272/272
[00:56<00:00,  4.85it/s]
             Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00,  6.14it/s]
               all       105      19108      0.826     0.664      0.732      0.528

    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

     156/170     5.77G     1.463     0.9847     0.921      1521       1024: 100%|          | 272/272
[00:56<00:00,  4.84it/s]
             Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00,  5.45it/s]
               all       105      19108        0.8     0.676      0.735      0.531

    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

     157/170     5.13G      1.47     0.9777     0.923       560       1024: 100%|          | 272/272
[00:55<00:00,  4.89it/s]
             Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          |
27/27 [00:06<00:00,  3.87it/s]
               all       105      19108      0.799     0.676      0.734      0.528

    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances      Size

     158/170     5.48G     1.472     0.9825     0.9224        73       1024: 100%|          | 272/272
[00:55<00:00,  4.90it/s]
             Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00,  6.17it/s]
               all       105      19108      0.792     0.668      0.733       0.53
```

```
    Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   159/170     3.99G      1.457     0.9701     0.9244       1146      1024: 100%|████████████| 272/272
[00:55<00:00,  4.89it/s]
            Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:04<00:00,  5.77it/s]

             all        105      19108      0.812      0.674      0.736      0.532

    Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   160/170     5.11G      1.478     0.9791     0.9283       1338      1024: 100%|████████████| 272/272
[00:56<00:00,  4.82it/s]
            Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:07<00:00,  3.77it/s]
             all        105      19108      0.813      0.667      0.735      0.53

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

    Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   161/170     2.82G      1.509      1.002     0.9226        373      1024: 100%|████████████| 272/272
[00:55<00:00,  4.89it/s]
            Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:04<00:00,  5.79it/s]
             all        105      19108      0.766      0.664      0.723      0.515

    Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   162/170     3.64G      1.494     0.9896     0.9212        122      1024: 100%|████████████| 272/272
[00:55<00:00,  4.88it/s]
            Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:04<00:00,  6.02it/s]
             all        105      19108      0.796      0.644      0.72      0.515

    Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size

   163/170     3.73G       1.47     0.9694     0.9213        444      1024: 100%|████████████| 272/272
[00:54<00:00,  5.03it/s]
            Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|████████|
27/27 [00:04<00:00,  6.04it/s]

             all        105      19108      0.787      0.656      0.724      0.513
```

```
     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
    164/170    3.32G    1.494     0.988    0.9221       299      1024: 100%|          | 272/272 [00:54<00:00,  5.00it/s]
           Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          | 27/27 [00:06<00:00,  4.22it/s]
             all     105     19108      0.775    0.655    0.719    0.515

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
    165/170    3.15G    1.482    0.9744    0.9188       285      1024: 100%|          | 272/272 [00:52<00:00,  5.15it/s]
           Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          | 27/27 [00:07<00:00,  3.66it/s]
             all     105     19108      0.779    0.659    0.722    0.518

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
    166/170    3.03G    1.473    0.9787    0.9225       308      1024: 100%|          | 272/272 [00:53<00:00,  5.11it/s]
           Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          | 27/27 [00:05<00:00,  4.71it/s]
             all     105     19108      0.803    0.646    0.722    0.518

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
    167/170    2.63G    1.461    0.9543    0.9133       184      1024: 100%|          | 272/272 [00:55<00:00,  4.91it/s]
           Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          | 27/27 [00:04<00:00,  5.61it/s]
             all     105     19108       0.79    0.652    0.725    0.516

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
    168/170     3.4G    1.479    0.9687    0.9217       566      1024: 100%|          | 272/272 [00:55<00:00,  4.91it/s]
           Class    Images  Instances      Box(P        R      mAP50  mAP50-95): 100%|          | 27/27 [00:04<00:00,  6.11it/s]
             all     105     19108      0.808    0.647    0.726     0.52

     Epoch    GPU_mem  box_loss  cls_loss  dfl_loss  Instances      Size
    169/170    3.17G    1.472    0.9704    0.9188       259      1024: 100%|          | 272/272 [00:55<00:00,  4.92it/s]
```

```
           Class    Images Instances    Box(P      R    mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00,  6.03it/s]
             all      105    19108     0.792    0.654    0.723    0.516

     Epoch   GPU_mem  box_loss  cls_loss  dfl_loss Instances      Size

  170/170    4.59G    1.459    0.9561    0.9193      396    1024: 100%|          | 272/272
[00:55<00:00,  4.92it/s]
           Class    Images Instances    Box(P      R    mAP50  mAP50-95): 100%|          |
27/27 [00:04<00:00,  6.02it/s]
             all      105    19108     0.783    0.653    0.724    0.518
```

170 epochs completed in 2.924 hours.
Optimizer stripped from runs/detect/pcb_identifier/weights/last.pt, 6.3MB
Optimizer stripped from runs/detect/pcb_identifier/weights/best.pt, 6.3MB

Validating runs/detect/pcb_identifier/weights/best.pt...
Ultralytics 8.3.39 🚀 Python-3.10.12 torch-2.5.1+cu121 CUDA:0 (Tesla T4, 15102MiB)
Model summary (fused): 168 layers, 3,008,183 parameters, 0 gradients, 8.1 GFLOPs

```
           Class    Images Instances    Box(P      R    mAP50  mAP50-95): 100%|          |
27/27 [00:11<00:00,  2.34it/s]

             all      105    19108     0.811    0.672    0.737    0.532
          Button       14       45     0.844    0.963    0.981    0.817
       Capacitor      104     7251     0.807     0.42    0.592    0.315
       Connector       76      659     0.803    0.868    0.885    0.677
           Diode       11       53      0.63    0.415    0.443    0.331
Electrolytic Capacitor      15      160     0.907    0.931    0.962    0.692
              IC       95     1322     0.831    0.905    0.925    0.698
         Inductor       12       45     0.957    0.622    0.735    0.563
             Led       18      127     0.812    0.709    0.797    0.573
            Pads       20      143     0.875    0.259    0.364    0.245
            Pins       10      151     0.563    0.861    0.797    0.556
         Resistor      104     8600     0.762    0.281    0.465    0.232
          Switch       11       28     0.928    0.924    0.936    0.805
       Transistor       58      524     0.823    0.577    0.691    0.412
```
Speed: 0.6ms preprocess, 10.8ms inference, 0.0ms loss, 11.1ms postprocess per image
Results saved to **runs/detect/pcb_identifier**
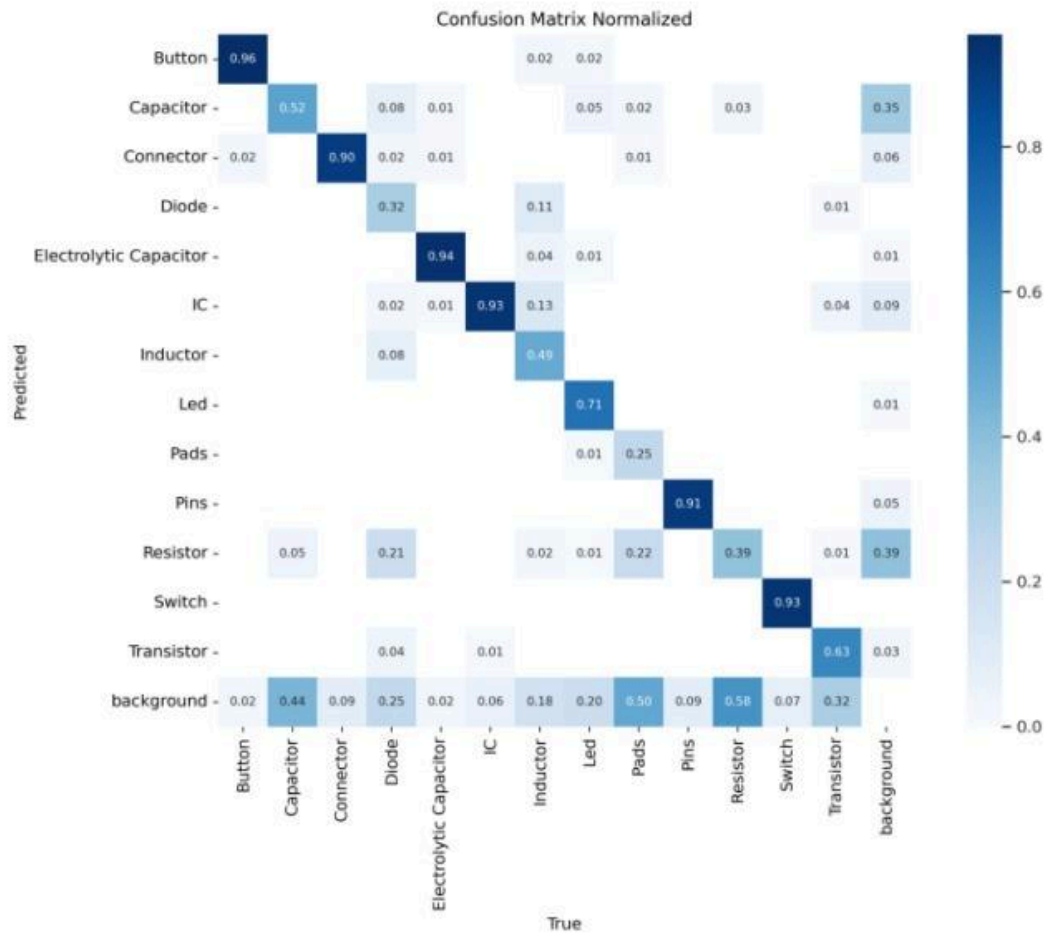
Step 2.5: Training Model Output Analysis
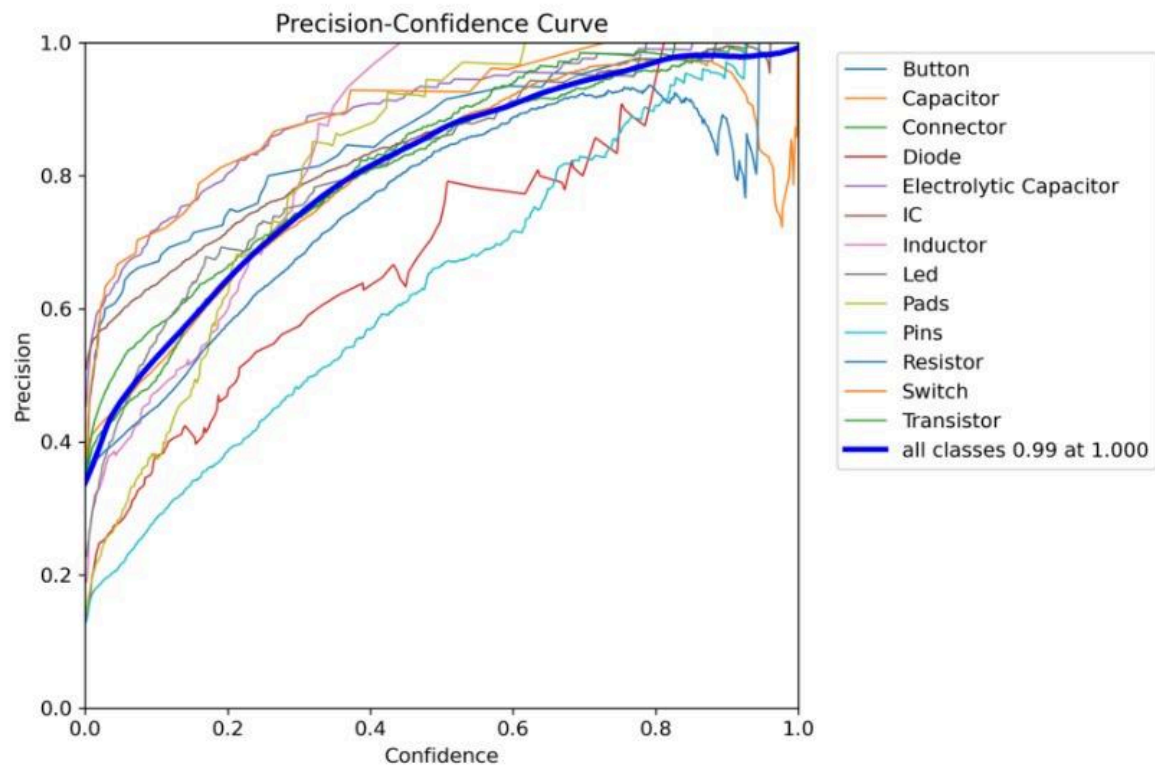

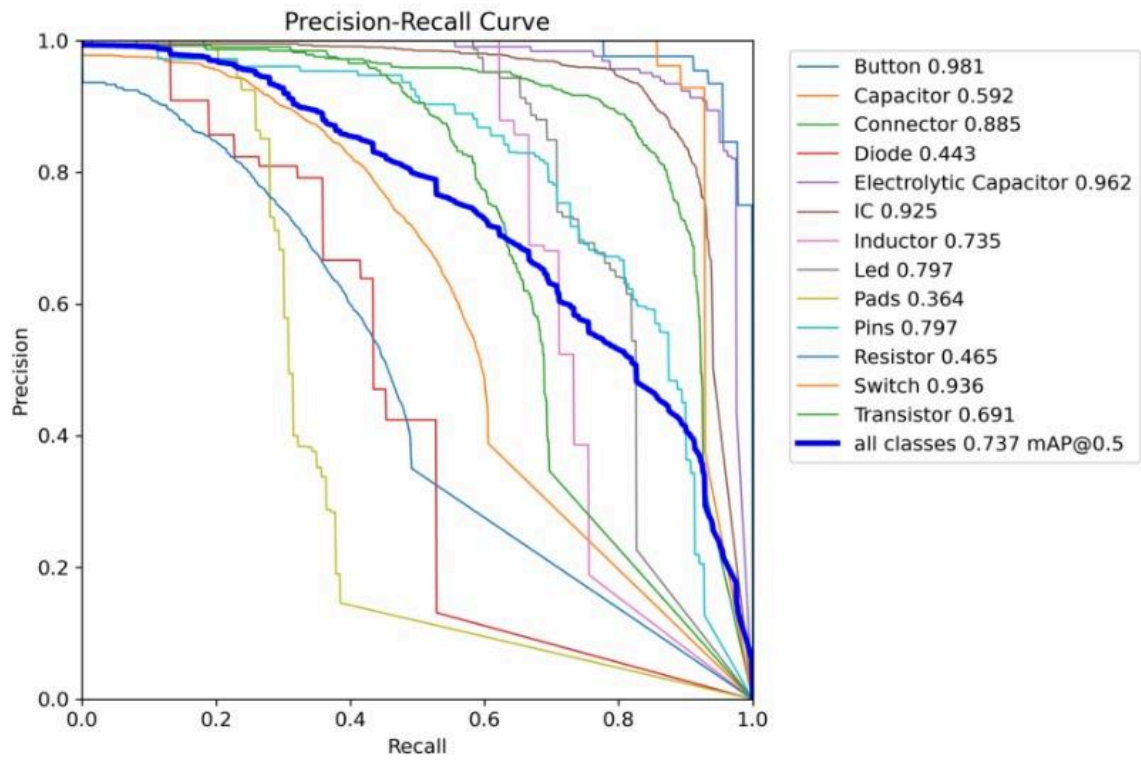Figure 2: Normalized Confusion Matrix

Figure 3: Precision-Confidence Curve

Figure 4: Precision-Recall Curve

Step 3: Evaluation

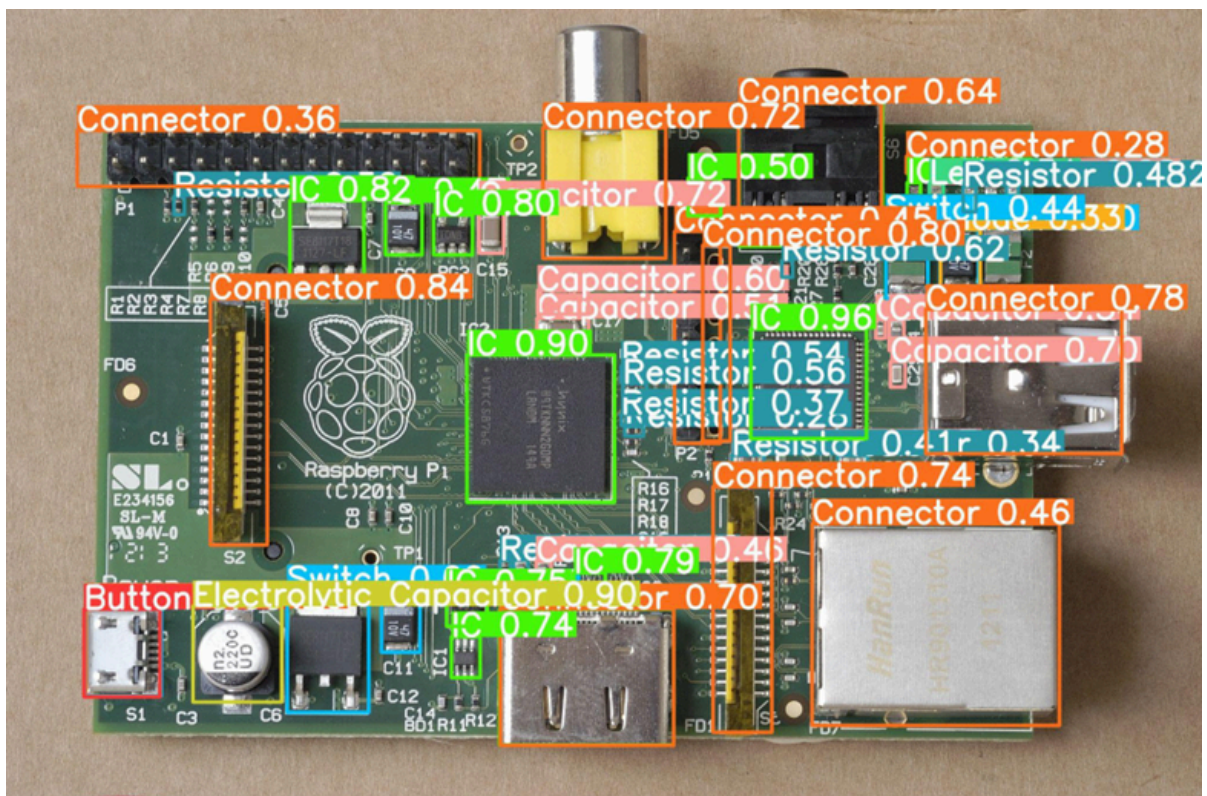Figure 5: Arduino Mega First Test Image Result

Figure 6: Arduino Uno Second Test Image Result

Figure 7: Raspberry Pi Third Test Image Result