Data Initialization

In [2]:
```
from torchvision.datasets import Cityscapes
import torchvision.transforms as T
from PIL import Image, ImageDraw
from ultralytics import YOLO
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
import torch
import torchvision
import torch.nn as nn
import torch.nn.functional as F
from torchvision import transforms
import numpy as np
import cv2
import json
import glob
import tqdm
import torch
from torchvision.models.detection.faster_rcnn import FastRCNNPredictor
```

In [3]:
```
# loading some images
rand_img = mpimg.imread('P2_Dhaka_COCO/train/IMG_0006-0529_jpg.rf.698862398084e4ad3
plt.imshow(rand_img)
plt.axis('off')
plt.show()
```

2 model object detection benchmark

In [2]:
```
import torch
import torchvision

print(torch.__version__)
print(torchvision.__version__)
print(torch.version.cuda)
print(torch.backends.cudnn.version())
```

```
2.2.0+cu121
0.17.0+cu121
12.1
8801
```

YOLO 11

In [5]:
```
yolo_model = YOLO('yolo11l.pt')
yolo_model.train(data='P2-Dhaka-Dataset/data.yaml', epochs = 10, imgsz=640, batch=8
```

```
New https://pypi.org/project/ultralytics/8.3.128 available  Update with 'pip install
-U ultralytics'
Ultralytics 8.3.126  Python-3.10.13 torch-2.2.0+cu121 CUDA:0 (NVIDIA GeForce RTX 206
0 SUPER, 8192MiB)
engine\trainer: agnostic_nms=False, amp=True, augment=False, auto_augment=randaugmen
t, batch=8, bgr=0.0, box=7.5, cache=False, cfg=None, classes=None, close_mosaic=10,
cls=0.5, conf=None, copy_paste=0.0, copy_paste_mode=flip, cos_lr=False, cutmix=0.0,
data=P2-Dhaka-Dataset/data.yaml, degrees=0.0, deterministic=True, device=cuda:0, dfl
=1.5, dnn=False, dropout=0.0, dynamic=False, embed=None, epochs=10, erasing=0.4, exi
st_ok=False, fliplr=0.5, flipud=0.0, format=torchscript, fraction=1.0, freeze=None,
half=False, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, imgsz=640, int8=False, iou=0.7, keras
=False, kobj=1.0, line_width=None, lr0=0.01, lrf=0.01, mask_ratio=4, max_det=300, mi
xup=0.0, mode=train, model=yolo11l.pt, momentum=0.937, mosaic=1.0, multi_scale=Fals
e, name=train41, nbs=64, nms=False, opset=None, optimize=False, optimizer=auto, over
lap_mask=True, patience=100, perspective=0.0, plots=True, pose=12.0, pretrained=Tru
e, profile=False, project=None, rect=False, resume=False, retina_masks=False, save=T
rue, save_conf=False, save_crop=False, save_dir=runs\detect\train41, save_frames=Fal
se, save_json=False, save_period=-1, save_txt=False, scale=0.5, seed=0, shear=0.0, s
how=False, show_boxes=True, show_conf=True, show_labels=True, simplify=True, single_
cls=False, source=None, split=val, stream_buffer=False, task=detect, time=None, trac
ker=botsort.yaml, translate=0.1, val=True, verbose=True, vid_stride=1, visualize=Fal
se, warmup_bias_lr=0.1, warmup_epochs=3.0, warmup_momentum=0.8, weight_decay=0.0005,
workers=8, workspace=None
Overriding model.yaml nc=80 with nc=8

                   from  n    params  module                                       a
rguments
  0                  -1  1      1856  ultralytics.nn.modules.conv.Conv
[3, 64, 3, 2]
  1                  -1  1     73984  ultralytics.nn.modules.conv.Conv
[64, 128, 3, 2]
  2                  -1  2    173824  ultralytics.nn.modules.block.C3k2
[128, 256, 2, True, 0.25]
  3                  -1  1    590336  ultralytics.nn.modules.conv.Conv
[256, 256, 3, 2]
  4                  -1  2    691712  ultralytics.nn.modules.block.C3k2
[256, 512, 2, True, 0.25]
  5                  -1  1   2360320  ultralytics.nn.modules.conv.Conv
[512, 512, 3, 2]
  6                  -1  2   2234368  ultralytics.nn.modules.block.C3k2
[512, 512, 2, True]
  7                  -1  1   2360320  ultralytics.nn.modules.conv.Conv
[512, 512, 3, 2]
  8                  -1  2   2234368  ultralytics.nn.modules.block.C3k2
[512, 512, 2, True]
  9                  -1  1    656896  ultralytics.nn.modules.block.SPPF
[512, 512, 5]
 10                  -1  2   1455616  ultralytics.nn.modules.block.C2PSA
[512, 512, 2]
 11                  -1  1         0  torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']
 12             [-1, 6]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 13                  -1  2   2496512  ultralytics.nn.modules.block.C3k2
[1024, 512, 2, True]
 14                  -1  1         0  torch.nn.modules.upsampling.Upsample
```

```
[None, 2, 'nearest']
 15             [-1, 4]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 16                 -1  2    756736  ultralytics.nn.modules.block.C3k2
[1024, 256, 2, True]
 17                 -1  1    590336  ultralytics.nn.modules.conv.Conv
[256, 256, 3, 2]
 18            [-1, 13]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 19                 -1  2   2365440  ultralytics.nn.modules.block.C3k2
[768, 512, 2, True]
 20                 -1  1   2360320  ultralytics.nn.modules.conv.Conv
[512, 512, 3, 2]
 21            [-1, 10]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 22                 -1  2   2496512  ultralytics.nn.modules.block.C3k2
[1024, 512, 2, True]
 23        [16, 19, 22]  1   1417192  ultralytics.nn.modules.head.Detect
[8, [256, 512, 512]]
YOLO11l summary: 357 layers, 25,316,648 parameters, 25,316,632 gradients, 87.3 GFLOP
s

Transferred 1009/1015 items from pretrained weights
TensorBoard: Start with 'tensorboard --logdir runs\detect\train41', view at http://l
ocalhost:6006/
Freezing layer 'model.23.dfl.conv.weight'
AMP: running Automatic Mixed Precision (AMP) checks...
AMP: checks passed
train: Fast image access  (ping: 0.10.0 ms, read: 427.437.3 MB/s, size: 59.8 KB)
train: Scanning D:\ery\School\Jupyter Notebooks\P2-Dhaka-Dataset\train\labels... 477
9 images, 5 backgrounds, 0 corrupt: 100%|██████████| 4779/4779 [00:02<00:00, 1879.87
it/s]
train: New cache created: D:\ery\School\Jupyter Notebooks\P2-Dhaka-Dataset\train\lab
els.cache
val: Fast image access  (ping: 0.10.0 ms, read: 352.389.5 MB/s, size: 58.1 KB)
val: Scanning D:\ery\School\Jupyter Notebooks\P2-Dhaka-Dataset\valid\labels... 604 i
mages, 0 backgrounds, 0 corrupt: 100%|██████████| 604/604 [00:00<00:00, 1114.81it/s]
val: New cache created: D:\ery\School\Jupyter Notebooks\P2-Dhaka-Dataset\valid\label
s.cache
Plotting labels to runs\detect\train41\labels.jpg...
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and dete
rmining best 'optimizer', 'lr0' and 'momentum' automatically...
optimizer: AdamW(lr=0.000833, momentum=0.9) with parameter groups 167 weight(decay=
0.0), 174 weight(decay=0.0005), 173 bias(decay=0.0)
TensorBoard: model graph visualization added
Image sizes 640 train, 640 val
Using 8 dataloader workers
Logging results to runs\detect\train41
Starting training for 10 epochs...
Closing dataloader mosaic

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
       1/10      5.81G      1.198      1.233      1.206         16        640: 100%|
██████████| 598/598 [03:49<00:00,  2.60it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.23it/s]
                   all        604       6184      0.682      0.488      0.567
0.328

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       2/10      5.72G      1.214       1.05      1.237         29        640: 100%|
██████████| 598/598 [03:25<00:00,  2.92it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.23it/s]
                   all        604       6184      0.684      0.515      0.583
0.347

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       3/10      5.77G      1.181     0.9761      1.214         15        640: 100%|
██████████| 598/598 [03:20<00:00,  2.98it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.24it/s]
                   all        604       6184      0.686      0.545      0.609
0.366

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       4/10      5.77G      1.123     0.8834      1.182         15        640: 100%|
██████████| 598/598 [03:19<00:00,  3.00it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.27it/s]
                   all        604       6184      0.732       0.62      0.678
0.422

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       5/10      5.78G      1.056     0.7894      1.142         27        640: 100%|
██████████| 598/598 [03:19<00:00,  3.00it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:12<00:00,  3.05it/s]
                   all        604       6184      0.771      0.646      0.729
0.461

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       6/10      5.78G     0.9906     0.7186      1.104         30        640: 100%|
██████████| 598/598 [03:19<00:00,  3.00it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.35it/s]
                   all        604       6184      0.826      0.649      0.745
0.475

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       7/10      5.76G     0.9402     0.6539       1.07         20        640: 100%|
██████████| 598/598 [03:19<00:00,  3.00it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.39it/s]
                   all        604       6184      0.855      0.666      0.767
0.495

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
       8/10       5.8G     0.8869     0.6026      1.047         27        640: 100%|
██████████| 598/598 [03:19<00:00,  3.00it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.44it/s]
                   all        604       6184      0.816      0.698      0.782
0.514

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       9/10      5.78G     0.8368     0.5516      1.017         27        640: 100%|
██████████| 598/598 [03:19<00:00,  2.99it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.43it/s]
                   all        604       6184       0.84      0.709      0.791
0.528

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      10/10      5.78G     0.7876     0.5057     0.9913         31        640: 100%|
██████████| 598/598 [03:19<00:00,  3.00it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:11<00:00,  3.36it/s]
                   all        604       6184      0.845      0.715      0.812
0.548

10 epochs completed in 0.617 hours.
Optimizer stripped from runs\detect\train41\weights\last.pt, 51.2MB
Optimizer stripped from runs\detect\train41\weights\best.pt, 51.2MB

Validating runs\detect\train41\weights\best.pt...
Ultralytics 8.3.126  Python-3.10.13 torch-2.2.0+cu121 CUDA:0 (NVIDIA GeForce RTX 206
0 SUPER, 8192MiB)
YOLO11l summary (fused): 190 layers, 25,285,480 parameters, 0 gradients, 86.6 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 38/38 [00:12<00:00,  2.93it/s]
                   all        604       6184      0.848      0.714      0.812
0.548
               bicycle        150        198       0.78      0.581      0.697
0.407
                   bus        378        652       0.88      0.777      0.861
0.663
                   car        575       1934      0.934      0.804        0.9
0.692
                   cng        348        517      0.868      0.762      0.852
0.666
            motorcycle        315        516      0.888      0.715      0.825
0.457
         other-vehicle        114        176      0.779      0.756      0.817
0.496
                person        498       1726       0.83      0.589      0.732
0.427
              rickshaw        225        465      0.826      0.727      0.812
0.574
Speed: 0.2ms preprocess, 10.6ms inference, 0.0ms loss, 2.0ms postprocess per image
Results saved to runs\detect\train41
```

Out[5]:
```
ultralytics.utils.metrics.DetMetrics object with attributes:

ap_class_index: array([0, 1, 2, 3, 4, 5, 6, 7])
box: ultralytics.utils.metrics.Metric object
confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at 0x000001B0A
3BF2E30>
curves: ['Precision-Recall(B)', 'F1-Confidence(B)', 'Precision-Confidence(B)', 'Re
call-Confidence(B)']
curves_results: [[array([          0,    0.001001,    0.002002,    0.003003,    0.
004004,    0.005005,    0.006006,    0.007007,    0.008008,    0.009009,     0.010
01,    0.011011,    0.012012,    0.013013,    0.014014,    0.015015,    0.016016,
0.017017,    0.018018,    0.019019,     0.02002,    0.021021,    0.022022,    0.02
3023,
          0.024024,    0.025025,    0.026026,    0.027027,    0.028028,    0.02902
9,     0.03003,    0.031031,    0.032032,    0.033033,    0.034034,    0.035035,
0.036036,    0.037037,    0.038038,    0.039039,     0.04004,    0.041041,    0.04
2042,    0.043043,    0.044044,    0.045045,    0.046046,    0.047047,
          0.048048,    0.049049,     0.05005,    0.051051,    0.052052,    0.05305
3,    0.054054,    0.055055,    0.056056,    0.057057,    0.058058,    0.059059,
0.06006,    0.061061,    0.062062,    0.063063,    0.064064,    0.065065,    0.066
066,    0.067067,    0.068068,    0.069069,     0.07007,    0.071071,
          0.072072,    0.073073,    0.074074,    0.075075,    0.076076,    0.07707
7,    0.078078,    0.079079,     0.08008,    0.081081,    0.082082,    0.083083,
0.084084,    0.085085,    0.086086,    0.087087,    0.088088,    0.089089,     0.0
9009,    0.091091,    0.092092,    0.093093,    0.094094,    0.095095,
          0.096096,    0.097097,    0.098098,    0.099099,       0.1001,       0.101
1,      0.1021,      0.1031,      0.1041,     0.10511,     0.10611,     0.10711,
0.10811,     0.10911,     0.11011,     0.11111,     0.11211,     0.11311,     0.11
411,     0.11512,     0.11612,     0.11712,     0.11812,     0.11912,
            0.12012,     0.12112,     0.12212,     0.12312,     0.12412,     0.1251
3,     0.12613,     0.12713,     0.12813,     0.12913,     0.13013,     0.13113,
0.13213,     0.13313,     0.13413,     0.13514,     0.13614,     0.13714,     0.13
814,     0.13914,     0.14014,     0.14114,     0.14214,     0.14314,
            0.14414,     0.14515,     0.14615,     0.14715,     0.14815,     0.1491
5,     0.15015,     0.15115,     0.15215,     0.15315,     0.15415,     0.15516,
0.15616,     0.15716,     0.15816,     0.15916,     0.16016,     0.16116,     0.16
216,     0.16316,     0.16416,     0.16517,     0.16617,     0.16717,
            0.16817,     0.16917,     0.17017,     0.17117,     0.17217,     0.1731
7,     0.17417,     0.17518,     0.17618,     0.17718,     0.17818,     0.17918,
0.18018,     0.18118,     0.18218,     0.18318,     0.18418,     0.18519,     0.18
619,     0.18719,     0.18819,     0.18919,     0.19019,     0.19119,
            0.19219,     0.19319,     0.19419,      0.1952,      0.1962,      0.197
2,      0.1982,      0.1992,      0.2002,      0.2012,      0.2022,      0.2032,
0.2042,     0.20521,     0.20621,     0.20721,     0.20821,     0.20921,     0.210
21,     0.21121,     0.21221,     0.21321,     0.21421,     0.21522,
            0.21622,     0.21722,     0.21822,     0.21922,     0.22022,     0.2212
2,     0.22222,     0.22322,     0.22422,     0.22523,     0.22623,     0.22723,
0.22823,     0.22923,     0.23023,     0.23123,     0.23223,     0.23323,     0.23
423,     0.23524,     0.23624,     0.23724,     0.23824,     0.23924,
            0.24024,     0.24124,     0.24224,     0.24324,     0.24424,     0.2452
5,     0.24625,     0.24725,     0.24825,     0.24925,     0.25025,     0.25125,
0.25225,     0.25325,     0.25425,     0.25526,     0.25626,     0.25726,     0.25
826,     0.25926,     0.26026,     0.26126,     0.26226,     0.26326,
            0.26426,     0.26527,     0.26627,     0.26727,     0.26827,     0.2692
7,     0.27027,     0.27127,     0.27227,     0.27327,     0.27427,     0.27528,
0.27628,     0.27728,     0.27828,     0.27928,     0.28028,     0.28128,     0.28
```

```
228,     0.28328,     0.28428,     0.28529,     0.28629,     0.28729,
          0.28829,     0.28929,     0.29029,     0.29129,     0.29229,     0.2932
9,     0.29429,      0.2953,      0.2963,      0.2973,      0.2983,      0.2993,
0.3003,      0.3013,      0.3023,      0.3033,      0.3043,     0.30531,     0.306
31,     0.30731,     0.30831,     0.30931,     0.31031,     0.31131,
          0.31231,     0.31331,     0.31431,     0.31532,     0.31632,     0.3173
2,     0.31832,     0.31932,     0.32032,     0.32132,     0.32232,     0.32332,
0.32432,     0.32533,     0.32633,     0.32733,     0.32833,     0.32933,     0.33
033,     0.33133,     0.33233,     0.33333,     0.33433,     0.33534,
          0.33634,     0.33734,     0.33834,     0.33934,     0.34034,     0.3413
4,     0.34234,     0.34334,     0.34434,     0.34535,     0.34635,     0.34735,
0.34835,     0.34935,     0.35035,     0.35135,     0.35235,     0.35335,     0.35
435,     0.35536,     0.35636,     0.35736,     0.35836,     0.35936,
          0.36036,     0.36136,     0.36236,     0.36336,     0.36436,     0.3653
7,     0.36637,     0.36737,     0.36837,     0.36937,     0.37037,     0.37137,
0.37237,     0.37337,     0.37437,     0.37538,     0.37638,     0.37738,     0.37
838,     0.37938,     0.38038,     0.38138,     0.38238,     0.38338,
          0.38438,     0.38539,     0.38639,     0.38739,     0.38839,     0.3893
9,     0.39039,     0.39139,     0.39239,     0.39339,     0.39439,      0.3954,
0.3964,      0.3974,      0.3984,      0.3994,      0.4004,      0.4014,      0.40
24,      0.4034,      0.4044,     0.40541,     0.40641,     0.40741,
          0.40841,     0.40941,     0.41041,     0.41141,     0.41241,     0.4134
1,     0.41441,     0.41542,     0.41642,     0.41742,     0.41842,     0.41942,
0.42042,     0.42142,     0.42242,     0.42342,     0.42442,     0.42543,     0.42
643,     0.42743,     0.42843,     0.42943,     0.43043,     0.43143,
          0.43243,     0.43343,     0.43443,     0.43544,     0.43644,     0.4374
4,     0.43844,     0.43944,     0.44044,     0.44144,     0.44244,     0.44344,
0.44444,     0.44545,     0.44645,     0.44745,     0.44845,     0.44945,     0.45
045,     0.45145,     0.45245,     0.45345,     0.45445,     0.45546,
          0.45646,     0.45746,     0.45846,     0.45946,     0.46046,     0.4614
6,     0.46246,     0.46346,     0.46446,     0.46547,     0.46647,     0.46747,
0.46847,     0.46947,     0.47047,     0.47147,     0.47247,     0.47347,     0.47
447,     0.47548,     0.47648,     0.47748,     0.47848,     0.47948,
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985,      0.4995,      0.5005,      0.5015,      0.5025,      0.5035,
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252,     0.52352,     0.52452,     0.52553,     0.52653,     0.52753,
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655,     0.54755,     0.54855,     0.54955,     0.55055,     0.55155,
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6,     0.55856,     0.55956,     0.56056,     0.56156,     0.56256,     0.56356,
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057,     0.57157,     0.57257,     0.57357,     0.57457,     0.57558,
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8,     0.58258,     0.58358,     0.58458,     0.58559,     0.58659,     0.58759,
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459,      0.5956,      0.5966,      0.5976,      0.5986,      0.5996,
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1,     0.60661,     0.60761,     0.60861,     0.60961,     0.61061,     0.61161,
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8,     0.67868,     0.67968,     0.68068,     0.68168,     0.68268,     0.68368,
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069,     0.69169,     0.69269,     0.69369,     0.69469,      0.6957,
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471,     0.71572,     0.71672,     0.71772,     0.71872,     0.71972,
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276,     0.76376,     0.76476,     0.76577,     0.76677,     0.76777,
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679,     0.78779,     0.78879,     0.78979,     0.79079,     0.79179,
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886,     0.85986,     0.86086,     0.86186,     0.86286,     0.86386,
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288,     0.88388,     0.88488,     0.88589,     0.88689,     0.88789,
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093,     0.93193,     0.93293,     0.93393,     0.93493,     0.93594,
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4,     0.94294,     0.94394,     0.94494,     0.94595,     0.94695,     0.94795,
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898,     0.97998,     0.98098,     0.98198,     0.98298,     0.98398,
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2022,    0.023023,
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0.036036,    0.037037,    0.038038,    0.039039,     0.04004,    0.041041,    0.04
2042,    0.043043,    0.044044,    0.045045,    0.046046,    0.047047,
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066,    0.067067,    0.068068,    0.069069,     0.07007,    0.071071,
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5,     0.24625,     0.24725,     0.24825,     0.24925,     0.25025,     0.25125,
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826,     0.25926,     0.26026,     0.26126,     0.26226,     0.26326,
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7,     0.27027,     0.27127,     0.27227,     0.27327,     0.27427,     0.27528,
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471,     0.71572,     0.71672,     0.71772,     0.71872,     0.71972,
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276,     0.76376,     0.76476,     0.76577,     0.76677,     0.76777,
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7,     0.77477,     0.77578,     0.77678,     0.77778,     0.77878,     0.77978,
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679,     0.78779,     0.78879,     0.78979,     0.79079,     0.79179,
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8,      0.7988,      0.7998,      0.8008,      0.8018,      0.8028,      0.8038,
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81,     0.81181,     0.81281,     0.81381,     0.81481,     0.81582,
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2,     0.82282,     0.82382,     0.82482,     0.82583,     0.82683,     0.82783,
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483,     0.83584,     0.83684,     0.83784,     0.83884,     0.83984,
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5,     0.84685,     0.84785,     0.84885,     0.84985,     0.85085,     0.85185,
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886,     0.85986,     0.86086,     0.86186,     0.86286,     0.86386,
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7,     0.87087,     0.87187,     0.87287,     0.87387,     0.87487,     0.87588,
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093,     0.93193,     0.93293,     0.93393,     0.93493,     0.93594,
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4,     0.94294,     0.94394,     0.94494,     0.94595,     0.94695,     0.94795,
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495,     0.95596,     0.95696,     0.95796,     0.95896,     0.95996,
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898,     0.97998,     0.98098,     0.98198,     0.98298,     0.98398,
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016,    0.017017,    0.018018,    0.019019,     0.02002,    0.021021,    0.022022,
0.023023,
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7,    0.078078,    0.079079,     0.08008,    0.081081,    0.082082,    0.083083,
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814,     0.13914,     0.14014,     0.14114,     0.14214,     0.14314,
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216,     0.16316,     0.16416,     0.16517,     0.16617,     0.16717,
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21,     0.21121,     0.21221,     0.21321,     0.21421,     0.21522,
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423,     0.23524,     0.23624,     0.23724,     0.23824,     0.23924,
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826,     0.25926,     0.26026,     0.26126,     0.26226,     0.26326,
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7,     0.27027,     0.27127,     0.27227,     0.27327,     0.27427,     0.27528,
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655,     0.54755,     0.54855,     0.54955,     0.55055,     0.55155,
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459,      0.5956,      0.5966,      0.5976,      0.5986,      0.5996,
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1,     0.60661,     0.60761,     0.60861,     0.60961,     0.61061,     0.61161,
0.61261,     0.61361,     0.61461,     0.61562,     0.61662,     0.61762,     0.61
862,     0.61962,     0.62062,     0.62162,     0.62262,     0.62362,
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069,     0.69169,     0.69269,     0.69369,     0.69469,      0.6957,
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471,     0.71572,     0.71672,     0.71772,     0.71872,     0.71972,
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874,     0.73974,     0.74074,     0.74174,     0.74274,     0.74374,
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276,     0.76376,     0.76476,     0.76577,     0.76677,     0.76777,
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7,     0.77477,     0.77578,     0.77678,     0.77778,     0.77878,     0.77978,
0.78078,     0.78178,     0.78278,     0.78378,     0.78478,     0.78579,     0.78
679,     0.78779,     0.78879,     0.78979,     0.79079,     0.79179,
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8,      0.7988,      0.7998,      0.8008,      0.8018,      0.8028,      0.8038,
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483,     0.83584,     0.83684,     0.83784,     0.83884,     0.83984,
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5,     0.84685,     0.84785,     0.84885,     0.84985,     0.85085,     0.85185,
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886,     0.85986,     0.86086,     0.86186,     0.86286,     0.86386,
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7,     0.87087,     0.87187,     0.87287,     0.87387,     0.87487,     0.87588,
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9,     0.89489,      0.8959,      0.8969,      0.8979,      0.8989,      0.8999,
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4,     0.94294,     0.94394,     0.94494,     0.94595,     0.94695,     0.94795,
0.94895,     0.94995,     0.95095,     0.95195,     0.95295,     0.95395,     0.95
495,     0.95596,     0.95696,     0.95796,     0.95896,     0.95996,
           0.96096,     0.96196,     0.96296,     0.96396,     0.96496,     0.9659
7,     0.96697,     0.96797,     0.96897,     0.96997,     0.97097,     0.97197,
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898,     0.97998,     0.98098,     0.98198,     0.98298,     0.98398,
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5,    0.016016,    0.017017,    0.018018,    0.019019,     0.02002,    0.021021,
0.022022,    0.023023,
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2042,    0.043043,    0.044044,    0.045045,    0.046046,    0.047047,
          0.048048,    0.049049,     0.05005,    0.051051,    0.052052,    0.05305
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0.06006,    0.061061,    0.062062,    0.063063,    0.064064,    0.065065,    0.066
066,    0.067067,    0.068068,    0.069069,     0.07007,    0.071071,
          0.072072,    0.073073,    0.074074,    0.075075,    0.076076,    0.07707
7,    0.078078,    0.079079,     0.08008,    0.081081,    0.082082,    0.083083,
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          0.096096,    0.097097,    0.098098,    0.099099,      0.1001,      0.101
1,      0.1021,      0.1031,      0.1041,     0.10511,     0.10611,     0.10711,
0.10811,     0.10911,     0.11011,     0.11111,     0.11211,     0.11311,     0.11
411,     0.11512,     0.11612,     0.11712,     0.11812,     0.11912,
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3,     0.12613,     0.12713,     0.12813,     0.12913,     0.13013,     0.13113,
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5,     0.15015,     0.15115,     0.15215,     0.15315,     0.15415,     0.15516,
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216,     0.16316,     0.16416,     0.16517,     0.16617,     0.16717,
           0.16817,     0.16917,     0.17017,     0.17117,     0.17217,     0.1731
7,     0.17417,     0.17518,     0.17618,     0.17718,     0.17818,     0.17918,
0.18018,     0.18118,     0.18218,     0.18318,     0.18418,     0.18519,     0.18
619,     0.18719,     0.18819,     0.18919,     0.19019,     0.19119,
           0.19219,     0.19319,     0.19419,      0.1952,      0.1962,      0.197
2,      0.1982,      0.1992,      0.2002,      0.2012,      0.2022,      0.2032,
0.2042,     0.20521,     0.20621,     0.20721,     0.20821,     0.20921,     0.210
21,     0.21121,     0.21221,     0.21321,     0.21421,     0.21522,
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2,     0.22222,     0.22322,     0.22422,     0.22523,     0.22623,     0.22723,
0.22823,     0.22923,     0.23023,     0.23123,     0.23223,     0.23323,     0.23
423,     0.23524,     0.23624,     0.23724,     0.23824,     0.23924,
           0.24024,     0.24124,     0.24224,     0.24324,     0.24424,     0.2452
5,     0.24625,     0.24725,     0.24825,     0.24925,     0.25025,     0.25125,
0.25225,     0.25325,     0.25425,     0.25526,     0.25626,     0.25726,     0.25
826,     0.25926,     0.26026,     0.26126,     0.26226,     0.26326,
           0.26426,     0.26527,     0.26627,     0.26727,     0.26827,     0.2692
7,     0.27027,     0.27127,     0.27227,     0.27327,     0.27427,     0.27528,
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7,     0.36637,     0.36737,     0.36837,     0.36937,     0.37037,     0.37137,
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838,     0.37938,     0.38038,     0.38138,     0.38238,     0.38338,
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3,     0.53453,     0.53554,     0.53654,     0.53754,     0.53854,     0.53954,
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6,     0.55856,     0.55956,     0.56056,     0.56156,     0.56256,     0.56356,
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7,     0.87087,     0.87187,     0.87287,     0.87387,     0.87487,     0.87588,
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4,     0.94294,     0.94394,     0.94494,     0.94595,     0.94695,     0.94795,
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495,     0.95596,     0.95696,     0.95796,     0.95896,     0.95996,
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7,     0.96697,     0.96797,     0.96897,     0.96997,     0.97097,     0.97197,
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898,     0.97998,     0.98098,     0.98198,     0.98298,     0.98398,
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0.997,       0.998,       0.999,           1]), array([[    0.87374,     0.87374,
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0],
       ...,
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0],
       [    0.90672,     0.90672,      0.8934, ...,           0,           0,
0],
       [    0.94624,     0.94624,     0.93763, ...,           0,           0,
0]]), 'Confidence', 'Recall']]
fitness: 0.5740375381818288
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/m
AP50-95(B)']
```
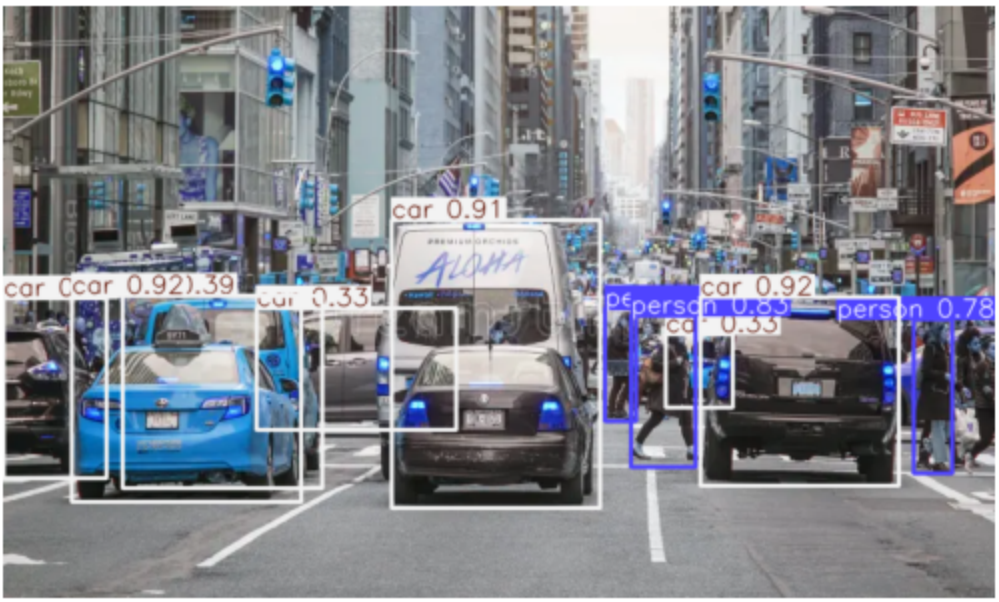

```
maps: array([    0.40651,     0.66276,      0.6916,     0.66623,     0.45685,
0.49612,     0.42696,     0.57377])
names: {0: 'bicycle', 1: 'bus', 2: 'car', 3: 'cng', 4: 'motorcycle', 5: 'other-veh
icle', 6: 'person', 7: 'rickshaw'}
plot: True
results_dict: {'metrics/precision(B)': 0.8482181479806836, 'metrics/recall(B)': 0.
713860146457338, 'metrics/mAP50(B)': 0.8119732530310549, 'metrics/mAP50-95(B)': 0.
5476002365319148, 'fitness': 0.5740375381818288}
save_dir: WindowsPath('runs/detect/train41')
speed: {'preprocess': 0.20483609272114275, 'inference': 10.625557781469183, 'los
s': 0.0008773177790660597, 'postprocess': 1.9636887417263342}
task: 'detect'
```

In [10]:
```
pred_test = yolo_model('street-traffic-new-york-typical-street-view-manhattan-manha
plt.imshow(pred_test[0].plot())
plt.axis('off')
plt.show()
```

```
image 1/1 D:\ery\School\Jupyter Notebooks\street-traffic-new-york-typical-street-vie
w-manhattan-manhattan-new-york-april-92272598.webp: 384x640 7 cars, 3 persons, 129.8
ms
Speed: 2.5ms preprocess, 129.8ms inference, 2.8ms postprocess per image at shape (1,
3, 384, 640)
```



In [11]:
```
# saving the model in onnx
yolo_model.export(format='onnx')
```

```
Ultralytics 8.3.107  Python-3.10.13 torch-2.5.1 CPU (AMD Ryzen 5 2600 Six-Core Proce
ssor)

PyTorch: starting from 'runs\detect\train14\weights\best.pt' with input shape (1, 3,
640, 640) BCHW and output shape(s) (1, 11, 8400) (5.2 MB)

ONNX: starting export with onnx 1.17.0 opset 19...
ONNX: slimming with onnxslim 0.1.50...
ONNX: export success  6.0s, saved as 'runs\detect\train14\weights\best.onnx' (10.1 M
B)

Export complete (7.0s)
Results saved to D:\ery\School\Jupyter Notebooks\runs\detect\train14\weights
Predict:         yolo predict task=detect model=runs\detect\train14\weights\best.onn
x imgsz=640
Validate:        yolo val task=detect model=runs\detect\train14\weights\best.onnx im
gsz=640 data=bdd100k--1/data.yaml
Visualize:       https://netron.app
```

Out[11]: 'runs\\detect\\train14\\weights\\best.onnx'

RT-DETR

In [51]:
```
!cd D:\ery\School\Jupyter Notebooks
```

In [7]:
```
from ultralytics import RTDETR
```

In [8]:
```
rtdetr_model = RTDETR('rtdetr-l.pt')
rtdetr_model.train(data='P2-Dhaka-Dataset/data.yaml', epochs = 10, imgsz=640, batch
```

```
New https://pypi.org/project/ultralytics/8.3.128 available  Update with 'pip install
-U ultralytics'
Ultralytics 8.3.126  Python-3.10.13 torch-2.2.0+cu121 CUDA:0 (NVIDIA GeForce RTX 206
0 SUPER, 8192MiB)
engine\trainer: agnostic_nms=False, amp=True, augment=False, auto_augment=randaugmen
t, batch=6, bgr=0.0, box=7.5, cache=False, cfg=None, classes=None, close_mosaic=10,
cls=0.5, conf=None, copy_paste=0.0, copy_paste_mode=flip, cos_lr=False, cutmix=0.0,
data=P2-Dhaka-Dataset/data.yaml, degrees=0.0, deterministic=True, device=cuda:0, dfl
=1.5, dnn=False, dropout=0.0, dynamic=False, embed=None, epochs=10, erasing=0.4, exi
st_ok=False, fliplr=0.5, flipud=0.0, format=torchscript, fraction=1.0, freeze=None,
half=False, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, imgsz=640, int8=False, iou=0.7, keras
=False, kobj=1.0, line_width=None, lr0=0.01, lrf=0.01, mask_ratio=4, max_det=300, mi
xup=0.0, mode=train, model=rtdetr-l.pt, momentum=0.937, mosaic=1.0, multi_scale=Fals
e, name=train42, nbs=64, nms=False, opset=None, optimize=False, optimizer=auto, over
lap_mask=True, patience=100, perspective=0.0, plots=True, pose=12.0, pretrained=Tru
e, profile=False, project=None, rect=False, resume=False, retina_masks=False, save=T
rue, save_conf=False, save_crop=False, save_dir=runs\detect\train42, save_frames=Fal
se, save_json=False, save_period=-1, save_txt=False, scale=0.5, seed=0, shear=0.0, s
how=False, show_boxes=True, show_conf=True, show_labels=True, simplify=True, single_
cls=False, source=None, split=val, stream_buffer=False, task=detect, time=None, trac
ker=botsort.yaml, translate=0.1, val=True, verbose=True, vid_stride=1, visualize=Fal
se, warmup_bias_lr=0.1, warmup_epochs=3.0, warmup_momentum=0.8, weight_decay=0.0005,
workers=8, workspace=None
Overriding model.yaml nc=80 with nc=8
WARNING no model scale passed. Assuming scale='l'.

                   from  n    params  module                                       a
rguments
  0                  -1  1     25248  ultralytics.nn.modules.block.HGStem
[3, 32, 48]
  1                  -1  6    155072  ultralytics.nn.modules.block.HGBlock
[48, 48, 128, 3, 6]
  2                  -1  1      1408  ultralytics.nn.modules.conv.DWConv
[128, 128, 3, 2, 1, False]
  3                  -1  6    839296  ultralytics.nn.modules.block.HGBlock
[128, 96, 512, 3, 6]
  4                  -1  1      5632  ultralytics.nn.modules.conv.DWConv
[512, 512, 3, 2, 1, False]
  5                  -1  6   1695360  ultralytics.nn.modules.block.HGBlock
[512, 192, 1024, 5, 6, True, False]
  6                  -1  6   2055808  ultralytics.nn.modules.block.HGBlock
[1024, 192, 1024, 5, 6, True, True]
  7                  -1  6   2055808  ultralytics.nn.modules.block.HGBlock
[1024, 192, 1024, 5, 6, True, True]
  8                  -1  1     11264  ultralytics.nn.modules.conv.DWConv
[1024, 1024, 3, 2, 1, False]
  9                  -1  6   6708480  ultralytics.nn.modules.block.HGBlock
[1024, 384, 2048, 5, 6, True, False]
 10                  -1  1    524800  ultralytics.nn.modules.conv.Conv
[2048, 256, 1, 1, None, 1, 1, False]
 11                  -1  1    789760  ultralytics.nn.modules.transformer.AIFI
[256, 1024, 8]
 12                  -1  1     66048  ultralytics.nn.modules.conv.Conv
[256, 256, 1, 1]
 13                  -1  1         0  torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']
```

```
 14                  7  1    262656  ultralytics.nn.modules.conv.Conv
[1024, 256, 1, 1, None, 1, 1, False]
 15            [-2, -1]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 16                  -1  3   2232320  ultralytics.nn.modules.block.RepC3
[512, 256, 3]
 17                  -1  1     66048  ultralytics.nn.modules.conv.Conv
[256, 256, 1, 1]
 18                  -1  1         0  torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']
 19                   3  1    131584  ultralytics.nn.modules.conv.Conv
[512, 256, 1, 1, None, 1, 1, False]
 20            [-2, -1]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 21                  -1  3   2232320  ultralytics.nn.modules.block.RepC3
[512, 256, 3]
 22                  -1  1    590336  ultralytics.nn.modules.conv.Conv
[256, 256, 3, 2]
 23            [-1, 17]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 24                  -1  3   2232320  ultralytics.nn.modules.block.RepC3
[512, 256, 3]
 25                  -1  1    590336  ultralytics.nn.modules.conv.Conv
[256, 256, 3, 2]
 26            [-1, 12]  1         0  ultralytics.nn.modules.conv.Concat
[1]
 27                  -1  3   2232320  ultralytics.nn.modules.block.RepC3
[512, 256, 3]
 28        [21, 24, 27]  1   7318292  ultralytics.nn.modules.head.RTDETRDecoder
[8, [256, 256, 256]]
rt-detr-l summary: 457 layers, 32,822,516 parameters, 32,822,516 gradients, 108.0 GF
LOPs

Transferred 926/941 items from pretrained weights
TensorBoard: Start with 'tensorboard --logdir runs\detect\train42', view at http://l
ocalhost:6006/
AMP: running Automatic Mixed Precision (AMP) checks...
AMP: checks passed
train: Fast image access  (ping: 0.10.0 ms, read: 361.344.3 MB/s, size: 59.8 KB)
train: Scanning D:\ery\School\Jupyter Notebooks\P2-Dhaka-Dataset\train\labels.cach
e... 4779 images, 5 backgrounds, 0 corrupt: 100%|██████████| 4779/4779 [00:00<?, ?i
t/s]
val: Fast image access  (ping: 0.10.1 ms, read: 291.463.1 MB/s, size: 58.1 KB)
val: Scanning D:\ery\School\Jupyter Notebooks\P2-Dhaka-Dataset\valid\labels.cache...
604 images, 0 backgrounds, 0 corrupt: 100%|██████████| 604/604 [00:00<?, ?it/s]
```

```
Plotting labels to runs\detect\train42\labels.jpg...
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and dete
rmining best 'optimizer', 'lr0' and 'momentum' automatically...
optimizer: AdamW(lr=0.000833, momentum=0.9) with parameter groups 143 weight(decay=
0.0), 206 weight(decay=0.000515625), 226 bias(decay=0.0)
TensorBoard: model graph visualization added
Image sizes 640 train, 640 val
Using 8 dataloader workers
Logging results to runs\detect\train42
Starting training for 10 epochs...
Closing dataloader mosaic

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       1/10      5.84G     0.6461      1.143     0.2057         16        640: 100%|
██████████| 797/797 [07:56<00:00,  1.67it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:13<00:00,  3.78it/s]
                   all        604       6184       0.79       0.63      0.701
0.454

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       2/10      5.97G     0.4385     0.5014     0.1114         30        640: 100%|
██████████| 797/797 [07:23<00:00,  1.80it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  3.98it/s]
                   all        604       6184      0.824      0.655      0.732
0.478

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
```

```
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       3/10       5.9G     0.4089     0.4674    0.09938         16        640: 100%|
██████████| 797/797 [07:17<00:00,  1.82it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  3.99it/s]
                   all        604       6184      0.829      0.702      0.767
0.51

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       4/10      5.96G     0.3843     0.4421    0.09032         22        640: 100%|
██████████| 797/797 [07:17<00:00,  1.82it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:13<00:00,  3.87it/s]
                   all        604       6184       0.83      0.682      0.764
0.505

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       5/10      5.98G     0.3639     0.4224    0.08475         26        640: 100%|
██████████| 797/797 [07:17<00:00,  1.82it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  3.99it/s]
                   all        604       6184      0.855      0.705      0.778
0.515

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
```

```
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       6/10      5.98G     0.3488     0.4048    0.07931         29        640: 100%|
██████████| 797/797 [07:16<00:00,  1.83it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  4.02it/s]
                   all        604       6184       0.86      0.727      0.799
0.538

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       7/10         6G     0.3349     0.3932    0.07467         20        640: 100%|
██████████| 797/797 [07:17<00:00,  1.82it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  4.01it/s]
                   all        604       6184      0.841      0.735      0.803
0.539

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       8/10      5.97G     0.3184     0.3772    0.06938         26        640: 100%|
██████████| 797/797 [07:17<00:00,  1.82it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  4.00it/s]
                   all        604       6184      0.861      0.751       0.82
0.555

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
```

```
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
       9/10      5.91G     0.3067     0.3632    0.06542         27        640: 100%|
██████████| 797/797 [07:15<00:00,  1.83it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  3.97it/s]
                   all        604       6184      0.868      0.758      0.823
0.558

      Epoch    GPU_mem  giou_loss   cls_loss    l1_loss  Instances       Size
E:\Anaconda\envs\CPE313_cenv_backup\lib\site-packages\torch\autograd\__init__.py:26
6: UserWarning: grid_sampler_2d_backward_cuda does not have a deterministic implemen
tation, but you set 'torch.use_deterministic_algorithms(True, warn_only=True)'. You
can file an issue at https://github.com/pytorch/pytorch/issues to help us prioritize
adding deterministic support for this operation. (Triggered internally at ..\aten\sr
c\ATen\Context.cpp:83.)
  Variable._execution_engine.run_backward(  # Calls into the C++ engine to run the b
ackward pass
      10/10       5.9G     0.2945     0.3501    0.06116         32        640: 100%|
██████████| 797/797 [07:18<00:00,  1.82it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:12<00:00,  3.93it/s]
                   all        604       6184       0.85      0.774      0.831
0.568

10 epochs completed in 1.285 hours.
Optimizer stripped from runs\detect\train42\weights\last.pt, 66.2MB
Optimizer stripped from runs\detect\train42\weights\best.pt, 66.2MB

Validating runs\detect\train42\weights\best.pt...
Ultralytics 8.3.126  Python-3.10.13 torch-2.2.0+cu121 CUDA:0 (NVIDIA GeForce RTX 206
0 SUPER, 8192MiB)
rt-detr-l summary: 302 layers, 32,000,180 parameters, 0 gradients, 103.5 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP50
-95): 100%|██████████| 51/51 [00:13<00:00,  3.68it/s]
```

```
                   all        604       6184      0.851      0.774      0.832
0.568
               bicycle        150        198      0.687      0.702      0.737
0.446
                   bus        378        652      0.903      0.839      0.885
0.684
                   car        575       1934      0.922      0.852      0.912
0.695
                   cng        348        517      0.893      0.775      0.843
0.675
            motorcycle        315        516      0.889      0.777      0.841
0.481
         other-vehicle        114        176      0.867      0.761      0.823
0.512
                person        498       1726      0.788      0.723      0.784
0.459
              rickshaw        225        465      0.857      0.766      0.829
0.595
Speed: 0.2ms preprocess, 12.6ms inference, 0.0ms loss, 1.2ms postprocess per image
Results saved to runs\detect\train42
```

Out[8]:
```
ultralytics.utils.metrics.DetMetrics object with attributes:

ap_class_index: array([0, 1, 2, 3, 4, 5, 6, 7])
box: ultralytics.utils.metrics.Metric object
confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at 0x000001B0A
3D58760>
curves: ['Precision-Recall(B)', 'F1-Confidence(B)', 'Precision-Confidence(B)', 'Re
call-Confidence(B)']
curves_results: [[array([          0,    0.001001,    0.002002,    0.003003,    0.
004004,    0.005005,    0.006006,    0.007007,    0.008008,    0.009009,     0.010
01,    0.011011,    0.012012,    0.013013,    0.014014,    0.015015,    0.016016,
0.017017,    0.018018,    0.019019,     0.02002,    0.021021,    0.022022,    0.02
3023,
          0.024024,    0.025025,    0.026026,    0.027027,    0.028028,    0.02902
9,     0.03003,    0.031031,    0.032032,    0.033033,    0.034034,    0.035035,
0.036036,    0.037037,    0.038038,    0.039039,     0.04004,    0.041041,    0.04
2042,    0.043043,    0.044044,    0.045045,    0.046046,    0.047047,
          0.048048,    0.049049,     0.05005,    0.051051,    0.052052,    0.05305
3,    0.054054,    0.055055,    0.056056,    0.057057,    0.058058,    0.059059,
0.06006,    0.061061,    0.062062,    0.063063,    0.064064,    0.065065,    0.066
066,    0.067067,    0.068068,    0.069069,     0.07007,    0.071071,
          0.072072,    0.073073,    0.074074,    0.075075,    0.076076,    0.07707
7,    0.078078,    0.079079,     0.08008,    0.081081,    0.082082,    0.083083,
0.084084,    0.085085,    0.086086,    0.087087,    0.088088,    0.089089,     0.0
9009,    0.091091,    0.092092,    0.093093,    0.094094,    0.095095,
          0.096096,    0.097097,    0.098098,    0.099099,       0.1001,       0.101
1,      0.1021,      0.1031,      0.1041,     0.10511,     0.10611,     0.10711,
0.10811,     0.10911,     0.11011,     0.11111,     0.11211,     0.11311,     0.11
411,     0.11512,     0.11612,     0.11712,     0.11812,     0.11912,
            0.12012,     0.12112,     0.12212,     0.12312,     0.12412,     0.1251
3,     0.12613,     0.12713,     0.12813,     0.12913,     0.13013,     0.13113,
0.13213,     0.13313,     0.13413,     0.13514,     0.13614,     0.13714,     0.13
814,     0.13914,     0.14014,     0.14114,     0.14214,     0.14314,
            0.14414,     0.14515,     0.14615,     0.14715,     0.14815,     0.1491
5,     0.15015,     0.15115,     0.15215,     0.15315,     0.15415,     0.15516,
0.15616,     0.15716,     0.15816,     0.15916,     0.16016,     0.16116,     0.16
216,     0.16316,     0.16416,     0.16517,     0.16617,     0.16717,
            0.16817,     0.16917,     0.17017,     0.17117,     0.17217,     0.1731
7,     0.17417,     0.17518,     0.17618,     0.17718,     0.17818,     0.17918,
0.18018,     0.18118,     0.18218,     0.18318,     0.18418,     0.18519,     0.18
619,     0.18719,     0.18819,     0.18919,     0.19019,     0.19119,
            0.19219,     0.19319,     0.19419,      0.1952,      0.1962,      0.197
2,      0.1982,      0.1992,      0.2002,      0.2012,      0.2022,      0.2032,
0.2042,     0.20521,     0.20621,     0.20721,     0.20821,     0.20921,     0.210
21,     0.21121,     0.21221,     0.21321,     0.21421,     0.21522,
            0.21622,     0.21722,     0.21822,     0.21922,     0.22022,     0.2212
2,     0.22222,     0.22322,     0.22422,     0.22523,     0.22623,     0.22723,
0.22823,     0.22923,     0.23023,     0.23123,     0.23223,     0.23323,     0.23
423,     0.23524,     0.23624,     0.23724,     0.23824,     0.23924,
            0.24024,     0.24124,     0.24224,     0.24324,     0.24424,     0.2452
5,     0.24625,     0.24725,     0.24825,     0.24925,     0.25025,     0.25125,
0.25225,     0.25325,     0.25425,     0.25526,     0.25626,     0.25726,     0.25
826,     0.25926,     0.26026,     0.26126,     0.26226,     0.26326,
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7,     0.27027,     0.27127,     0.27227,     0.27327,     0.27427,     0.27528,
0.27628,     0.27728,     0.27828,     0.27928,     0.28028,     0.28128,     0.28
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9,     0.29429,      0.2953,      0.2963,      0.2973,      0.2983,      0.2993,
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31,     0.30731,     0.30831,     0.30931,     0.31031,     0.31131,
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2,     0.31832,     0.31932,     0.32032,     0.32132,     0.32232,     0.32332,
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033,     0.33133,     0.33233,     0.33333,     0.33433,     0.33534,
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435,     0.35536,     0.35636,     0.35736,     0.35836,     0.35936,
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7,     0.36637,     0.36737,     0.36837,     0.36937,     0.37037,     0.37137,
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838,     0.37938,     0.38038,     0.38138,     0.38238,     0.38338,
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9,     0.39039,     0.39139,     0.39239,     0.39339,     0.39439,      0.3954,
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24,      0.4034,      0.4044,     0.40541,     0.40641,     0.40741,
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1,     0.41441,     0.41542,     0.41642,     0.41742,     0.41842,     0.41942,
0.42042,     0.42142,     0.42242,     0.42342,     0.42442,     0.42543,     0.42
643,     0.42743,     0.42843,     0.42943,     0.43043,     0.43143,
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4,     0.43844,     0.43944,     0.44044,     0.44144,     0.44244,     0.44344,
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045,     0.45145,     0.45245,     0.45345,     0.45445,     0.45546,
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6,     0.46246,     0.46346,     0.46446,     0.46547,     0.46647,     0.46747,
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447,     0.47548,     0.47648,     0.47748,     0.47848,     0.47948,
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985,      0.4995,      0.5005,      0.5015,      0.5025,      0.5035,
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1,     0.51051,     0.51151,     0.51251,     0.51351,     0.51451,     0.51552,
0.51652,     0.51752,     0.51852,     0.51952,     0.52052,     0.52152,     0.52
252,     0.52352,     0.52452,     0.52553,     0.52653,     0.52753,
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3,     0.53453,     0.53554,     0.53654,     0.53754,     0.53854,     0.53954,
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655,     0.54755,     0.54855,     0.54955,     0.55055,     0.55155,
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6,     0.55856,     0.55956,     0.56056,     0.56156,     0.56256,     0.56356,
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057,     0.57157,     0.57257,     0.57357,     0.57457,     0.57558,
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8,     0.58258,     0.58358,     0.58458,     0.58559,     0.58659,     0.58759,
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459,      0.5956,      0.5966,      0.5976,      0.5986,      0.5996,
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069,     0.69169,     0.69269,     0.69369,     0.69469,      0.6957,
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471,     0.71572,     0.71672,     0.71772,     0.71872,     0.71972,
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874,     0.73974,     0.74074,     0.74174,     0.74274,     0.74374,
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5,     0.75075,     0.75175,     0.75275,     0.75375,     0.75475,     0.75576,
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276,     0.76376,     0.76476,     0.76577,     0.76677,     0.76777,
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7,     0.77477,     0.77578,     0.77678,     0.77778,     0.77878,     0.77978,
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679,     0.78779,     0.78879,     0.78979,     0.79079,     0.79179,
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8,      0.7988,      0.7998,      0.8008,      0.8018,      0.8028,      0.8038,
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886,     0.85986,     0.86086,     0.86186,     0.86286,     0.86386,
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7,     0.87087,     0.87187,     0.87287,     0.87387,     0.87487,     0.87588,
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91,     0.90791,     0.90891,     0.90991,     0.91091,     0.91191,
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093,     0.93193,     0.93293,     0.93393,     0.93493,     0.93594,
          0.93694,     0.93794,     0.93894,     0.93994,     0.94094,     0.9419
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898,     0.97998,     0.98098,     0.98198,     0.98298,     0.98398,
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2022,    0.023023,
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9,     0.03003,    0.031031,    0.032032,    0.033033,    0.034034,    0.035035,
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2042,    0.043043,    0.044044,    0.045045,    0.046046,    0.047047,
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814,     0.13914,     0.14014,     0.14114,     0.14214,     0.14314,
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216,     0.16316,     0.16416,     0.16517,     0.16617,     0.16717,
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423,     0.23524,     0.23624,     0.23724,     0.23824,     0.23924,
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5,     0.24625,     0.24725,     0.24825,     0.24925,     0.25025,     0.25125,
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826,     0.25926,     0.26026,     0.26126,     0.26226,     0.26326,
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033,     0.33133,     0.33233,     0.33333,     0.33433,     0.33534,
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435,     0.35536,     0.35636,     0.35736,     0.35836,     0.35936,
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24,      0.4034,      0.4044,     0.40541,     0.40641,     0.40741,
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643,     0.42743,     0.42843,     0.42943,     0.43043,     0.43143,
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6,     0.46246,     0.46346,     0.46446,     0.46547,     0.46647,     0.46747,
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447,     0.47548,     0.47648,     0.47748,     0.47848,     0.47948,
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252,     0.52352,     0.52452,     0.52553,     0.52653,     0.52753,
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886,     0.85986,     0.86086,     0.86186,     0.86286,     0.86386,
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495,     0.95596,     0.95696,     0.95796,     0.95896,     0.95996,
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016,    0.017017,    0.018018,    0.019019,     0.02002,    0.021021,    0.022022,
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0.75676,     0.75776,     0.75876,     0.75976,     0.76076,     0.76176,     0.76
276,     0.76376,     0.76476,     0.76577,     0.76677,     0.76777,
          0.76877,     0.76977,     0.77077,     0.77177,     0.77277,     0.7737
7,     0.77477,     0.77578,     0.77678,     0.77778,     0.77878,     0.77978,
0.78078,     0.78178,     0.78278,     0.78378,     0.78478,     0.78579,     0.78
679,     0.78779,     0.78879,     0.78979,     0.79079,     0.79179,
          0.79279,     0.79379,     0.79479,      0.7958,      0.7968,      0.797
8,      0.7988,      0.7998,      0.8008,      0.8018,      0.8028,      0.8038,
0.8048,     0.80581,     0.80681,     0.80781,     0.80881,     0.80981,     0.810
81,     0.81181,     0.81281,     0.81381,     0.81481,     0.81582,
          0.81682,     0.81782,     0.81882,     0.81982,     0.82082,     0.8218
2,     0.82282,     0.82382,     0.82482,     0.82583,     0.82683,     0.82783,
0.82883,     0.82983,     0.83083,     0.83183,     0.83283,     0.83383,     0.83
483,     0.83584,     0.83684,     0.83784,     0.83884,     0.83984,
          0.84084,     0.84184,     0.84284,     0.84384,     0.84484,     0.8458
5,     0.84685,     0.84785,     0.84885,     0.84985,     0.85085,     0.85185,
0.85285,     0.85385,     0.85485,     0.85586,     0.85686,     0.85786,     0.85
886,     0.85986,     0.86086,     0.86186,     0.86286,     0.86386,
          0.86486,     0.86587,     0.86687,     0.86787,     0.86887,     0.8698
7,     0.87087,     0.87187,     0.87287,     0.87387,     0.87487,     0.87588,
0.87688,     0.87788,     0.87888,     0.87988,     0.88088,     0.88188,     0.88
288,     0.88388,     0.88488,     0.88589,     0.88689,     0.88789,
          0.88889,     0.88989,     0.89089,     0.89189,     0.89289,     0.8938
9,     0.89489,      0.8959,      0.8969,      0.8979,      0.8989,      0.8999,
0.9009,      0.9019,      0.9029,      0.9039,      0.9049,     0.90591,     0.906
91,     0.90791,     0.90891,     0.90991,     0.91091,     0.91191,
          0.91291,     0.91391,     0.91491,     0.91592,     0.91692,     0.9179
2,     0.91892,     0.91992,     0.92092,     0.92192,     0.92292,     0.92392,
0.92492,     0.92593,     0.92693,     0.92793,     0.92893,     0.92993,     0.93
093,     0.93193,     0.93293,     0.93393,     0.93493,     0.93594,
          0.93694,     0.93794,     0.93894,     0.93994,     0.94094,     0.9419
4,     0.94294,     0.94394,     0.94494,     0.94595,     0.94695,     0.94795,
0.94895,     0.94995,     0.95095,     0.95195,     0.95295,     0.95395,     0.95
495,     0.95596,     0.95696,     0.95796,     0.95896,     0.95996,
          0.96096,     0.96196,     0.96296,     0.96396,     0.96496,     0.9659
7,     0.96697,     0.96797,     0.96897,     0.96997,     0.97097,     0.97197,
0.97297,     0.97397,     0.97497,     0.97598,     0.97698,     0.97798,     0.97
898,     0.97998,     0.98098,     0.98198,     0.98298,     0.98398,
          0.98498,     0.98599,     0.98699,     0.98799,     0.98899,     0.9899
9,     0.99099,     0.99199,     0.99299,     0.99399,     0.99499,       0.996,
0.997,       0.998,       0.999,           1]), array([[    0.89899,     0.89899,
0.89899, ...,           0,           0,           0],
       [    0.95092,     0.95092,     0.95092, ...,           0,           0,
0],
       [    0.96587,     0.96587,     0.96587, ...,           0,           0,
0],
       ...,
       [    0.88068,     0.88068,     0.88068, ...,           0,           0,
0],
       [    0.95481,     0.95481,     0.95481, ...,           0,           0,
0],
       [    0.91183,     0.91183,     0.91183, ...,           0,           0,
0]]), 'Confidence', 'Recall']]
fitness: 0.5947840599865444
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/m
AP50-95(B)']
```
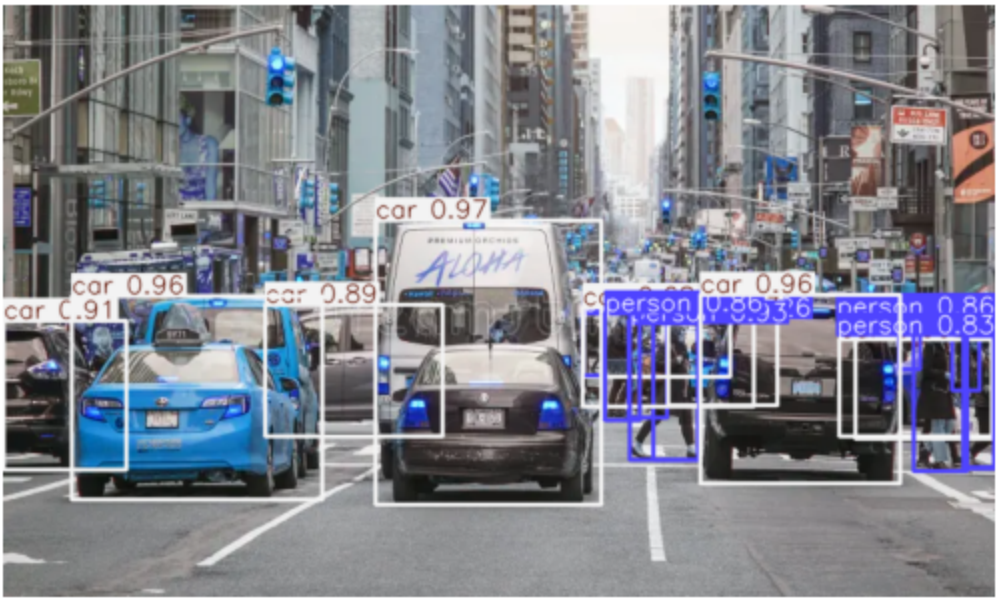

```
maps: array([    0.44644,     0.68414,      0.6946,     0.67502,     0.48136,
0.51188,     0.45883,     0.59542])
names: {0: 'bicycle', 1: 'bus', 2: 'car', 3: 'cng', 4: 'motorcycle', 5: 'other-veh
icle', 6: 'person', 7: 'rickshaw'}
plot: True
results_dict: {'metrics/precision(B)': 0.8507865080515644, 'metrics/recall(B)': 0.
7744094837763538, 'metrics/mAP50(B)': 0.8316855312569642, 'metrics/mAP50-95(B)':
0.568461674289831, 'fitness': 0.5947840599865444}
save_dir: WindowsPath('runs/detect/train42')
speed: {'preprocess': 0.17496456954381906, 'inference': 12.587439735115133, 'los
s': 0.0013117550531886394, 'postprocess': 1.2256470198440634}
task: 'detect'
```

In [9]:
```
test_image = Image.open('street-traffic-new-york-typical-street-view-manhattan-manh
plt.imshow(test_image)
plt.axis('off')
plt.show()
```

In [9]:
```
predrtdetr_test = rtdetr_model('street-traffic-new-york-typical-street-view-manhatt
plt.imshow(predrtdetr_test[0].plot())
plt.axis('off')
plt.show()
```

```
image 1/1 D:\ery\School\Jupyter Notebooks\street-traffic-new-york-typical-street-vie
w-manhattan-manhattan-new-york-april-92272598.webp: 640x640 10 cars, 10 persons, 51.
5ms
Speed: 3.5ms preprocess, 51.5ms inference, 108.9ms postprocess per image at shape
(1, 3, 640, 640)
```



In [10]:
```
rtdetr_model.export(format='onnx')
```

```
Ultralytics 8.3.107  Python-3.10.13 torch-2.5.1 CPU (AMD Ryzen 5 2600 Six-Core Proce
ssor)
rt-detr-l summary: 302 layers, 31,998,125 parameters, 0 gradients, 103.5 GFLOPs

PyTorch: starting from 'runs\detect\train25\weights\best.pt' with input shape (1, 3,
640, 640) BCHW and output shape(s) (1, 300, 11) (63.1 MB)

ONNX: starting export with onnx 1.12.0 opset 19...
ONNX: slimming with onnxslim 0.1.50...
ONNX: simplifier failure: FLOAT8E4M3FN
ONNX: export success  8.0s, saved as 'runs\detect\train25\weights\best.onnx' (122.5
MB)

Export complete (11.9s)
Results saved to D:\ery\School\Jupyter Notebooks\runs\detect\train25\weights
Predict:         yolo predict task=detect model=runs\detect\train25\weights\best.onn
x imgsz=640
Validate:        yolo val task=detect model=runs\detect\train25\weights\best.onnx im
gsz=640 data=bdd100k--1/data.yaml
Visualize:       https://netron.app
```

Out[10]:
```
'runs\\detect\\train25\\weights\\best.onnx'
```

In [18]:
```
torch.cuda.empty_cache()
```