In [1]:
```
from torchvision.models.detection import retinanet_resnet50_fpn_v2
import torch
```

In [3]:
```
model = retinanet_resnet50_fpn_v2(weights=None, weights_backbone='DEFAULT', num_cla
model.load_state_dict(torch.load('retinanet_weights.pth'))
model.eval()
model.to('cuda')
```

Out[3]:
```
RetinaNet(
  (backbone): BackboneWithFPN(
    (body): IntermediateLayerGetter(
      (conv1): Conv2d(3, 64, kernel_size=(7, 7), stride=(2, 2), padding=(3, 3), bi
as=False)
      (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_running_s
tats=True)
      (relu): ReLU(inplace=True)
      (maxpool): MaxPool2d(kernel_size=3, stride=2, padding=1, dilation=1, ceil_mo
de=False)
      (layer1): Sequential(
        (0): Bottleneck(
          (conv1): Conv2d(64, 64, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_runni
ng_stats=True)
          (conv2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_runni
ng_stats=True)
          (conv3): Conv2d(64, 256, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn3): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (relu): ReLU(inplace=True)
          (downsample): Sequential(
            (0): Conv2d(64, 256, kernel_size=(1, 1), stride=(1, 1), bias=False)
            (1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          )
        )
        (1): Bottleneck(
          (conv1): Conv2d(256, 64, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_runni
ng_stats=True)
          (conv2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_runni
ng_stats=True)
          (conv3): Conv2d(64, 256, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn3): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (relu): ReLU(inplace=True)
        )
        (2): Bottleneck(
          (conv1): Conv2d(256, 64, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_runni
ng_stats=True)
          (conv2): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(64, eps=1e-05, momentum=0.1, affine=True, track_runni
ng_stats=True)
          (conv3): Conv2d(64, 256, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn3): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (relu): ReLU(inplace=True)
        )
      )
```

```
      (layer2): Sequential(
        (0): Bottleneck(
          (conv1): Conv2d(256, 128, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(128, 128, kernel_size=(3, 3), stride=(2, 2), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(128, 512, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn3): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (relu): ReLU(inplace=True)
          (downsample): Sequential(
            (0): Conv2d(256, 512, kernel_size=(1, 1), stride=(2, 2), bias=False)
            (1): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          )
        )
        (1): Bottleneck(
          (conv1): Conv2d(512, 128, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(128, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(128, 512, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn3): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (relu): ReLU(inplace=True)
        )
        (2): Bottleneck(
          (conv1): Conv2d(512, 128, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(128, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(128, 512, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn3): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (relu): ReLU(inplace=True)
        )
        (3): Bottleneck(
          (conv1): Conv2d(512, 128, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(128, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(128, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(128, 512, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn3): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
```

```
          (relu): ReLU(inplace=True)
        )
      )
      (layer3): Sequential(
        (0): Bottleneck(
          (conv1): Conv2d(512, 256, kernel_size=(1, 1), stride=(1, 1), bias=False)
          (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(2, 2), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(256, 1024, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
          (downsample): Sequential(
            (0): Conv2d(512, 1024, kernel_size=(1, 1), stride=(2, 2), bias=False)
            (1): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          )
        )
        (1): Bottleneck(
          (conv1): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(256, 1024, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
        )
        (2): Bottleneck(
          (conv1): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(256, 1024, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
        )
        (3): Bottleneck(
          (conv1): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
```

```
          (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(256, 1024, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
        )
        (4): Bottleneck(
          (conv1): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(256, 1024, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
        )
        (5): Bottleneck(
          (conv1): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn1): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(256, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(256, 1024, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(1024, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
        )
      )
      (layer4): Sequential(
        (0): Bottleneck(
          (conv1): Conv2d(1024, 512, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn1): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(512, 512, kernel_size=(3, 3), stride=(2, 2), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(512, 2048, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(2048, eps=1e-05, momentum=0.1, affine=True, track_run
```

```
ning_stats=True)
          (relu): ReLU(inplace=True)
          (downsample): Sequential(
            (0): Conv2d(1024, 2048, kernel_size=(1, 1), stride=(2, 2), bias=False)
            (1): BatchNorm2d(2048, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          )
        )
        (1): Bottleneck(
          (conv1): Conv2d(2048, 512, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn1): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(512, 512, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(512, 2048, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(2048, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
        )
        (2): Bottleneck(
          (conv1): Conv2d(2048, 512, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn1): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv2): Conv2d(512, 512, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1), bias=False)
          (bn2): BatchNorm2d(512, eps=1e-05, momentum=0.1, affine=True, track_runn
ing_stats=True)
          (conv3): Conv2d(512, 2048, kernel_size=(1, 1), stride=(1, 1), bias=Fals
e)
          (bn3): BatchNorm2d(2048, eps=1e-05, momentum=0.1, affine=True, track_run
ning_stats=True)
          (relu): ReLU(inplace=True)
        )
      )
    )
    (fpn): FeaturePyramidNetwork(
      (inner_blocks): ModuleList(
        (0): Conv2dNormActivation(
          (0): Conv2d(512, 256, kernel_size=(1, 1), stride=(1, 1))
        )
        (1): Conv2dNormActivation(
          (0): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1))
        )
        (2): Conv2dNormActivation(
          (0): Conv2d(2048, 256, kernel_size=(1, 1), stride=(1, 1))
        )
      )
      (layer_blocks): ModuleList(
        (0-2): 3 x Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
        )
```

```
      )
      (extra_blocks): LastLevelP6P7(
        (p6): Conv2d(2048, 256, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1))
        (p7): Conv2d(256, 256, kernel_size=(3, 3), stride=(2, 2), padding=(1, 1))
      )
    )
  )
  (anchor_generator): AnchorGenerator()
  (head): RetinaNetHead(
    (classification_head): RetinaNetClassificationHead(
      (conv): Sequential(
        (0): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
        (1): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
        (2): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
        (3): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
      )
      (cls_logits): Conv2d(256, 81, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
    )
    (regression_head): RetinaNetRegressionHead(
      (conv): Sequential(
        (0): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
        (1): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
        (2): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
```

```
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
        (3): Conv2dNormActivation(
          (0): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1),
bias=False)
          (1): GroupNorm(32, 256, eps=1e-05, affine=True)
          (2): ReLU(inplace=True)
        )
      )
      (bbox_reg): Conv2d(256, 36, kernel_size=(3, 3), stride=(1, 1), padding=(1,
1))
    )
  )
  (transform): GeneralizedRCNNTransform(
      Normalize(mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225])
      Resize(min_size=(800,), max_size=1333, mode='bilinear')
  )
)
```

In [4]:
```
from PIL import Image
from torchvision import transforms as T

transform = T.Compose([T.ToTensor()])

image = Image.open('street-traffic-new-york-typical-street-view-manhattan-manhattan
img_tensor = transform(image).to('cuda')
```

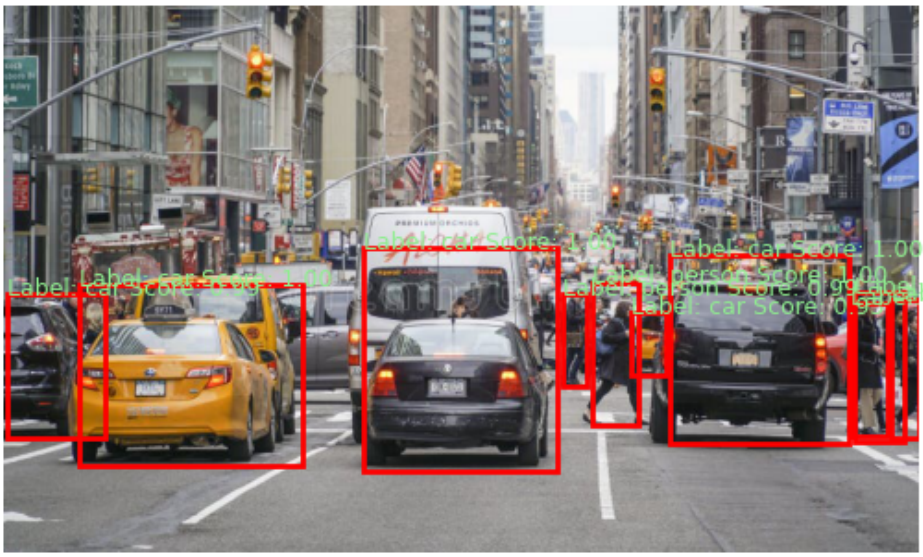
In [5]:
```
with torch.no_grad():
    predictions = model([img_tensor])
```

In [6]:
```
boxes = predictions[0]['boxes'].cpu().numpy()
labels = predictions[0]['labels'].cpu().numpy()
scores = predictions[0]['scores'].cpu().numpy()
```

In [7]:
```
threshold = 0.7
valid_boxes = boxes[scores > threshold]
valid_labels = labels[scores > threshold]
valid_scores = scores[scores > threshold]
```

In [9]:
```
import matplotlib.pyplot as plt
```

In [10]:
```
plt.imshow(image)
label_list = ['background','bicycle','bus','car','cng','motorcycle','other-vehicle'
for i in range(len(valid_boxes)):
    x1, y1, x2, y2 = valid_boxes[i]
    plt.gca().add_patch(plt.Rectangle((x1, y1), x2-x1, y2-y1, linewidth=2, edgecolo
    plt.text(x1, y1, f'Label: {label_list[valid_labels[i]]} Score: {valid_scores[i]
plt.axis('off')
plt.show()
```


Label: car Score: 1.00
Label: car Score: 1.00
Label: person Score: 0.99
Label: rickshaw Score: 0.94
Label: car Score: 0.91

In [ ]: