Question 5

March 7, 2023

References:

https://www.saama.com/different-kinds-convolutional-filters/

https://pytorch.org/tutorials/intermediate/torchvision_tutorial.html#testing-forward-method-optional

https://chat.openai.com/chat

https://learn.microsoft.com/en-us/windows/ai/windows-ml/tutorials/pytorch-analysis-train-model

https://github.com/kvgarimella/dl-demos/blob/main/demo04-convolution.ipynb

[1]:
```
import os
import numpy as np
import torch
from PIL import Image
import utils
class PennFudanDataset(torch.utils.data.Dataset):
    def __init__(self, root, transforms):
        self.root = root
        self.transforms = transforms
        # load all image files, sorting them to
        # ensure that they are aligned
        self.imgs = list(sorted(os.listdir(os.path.join(root, "PNGImages"))))
        self.masks = list(sorted(os.listdir(os.path.join(root, "PedMasks"))))

    def __getitem__(self, idx):
        # load images and masks
        img_path = os.path.join(self.root, "PNGImages", self.imgs[idx])
        mask_path = os.path.join(self.root, "PedMasks", self.masks[idx])
        img = Image.open(img_path).convert("RGB")
        # note that we haven't converted the mask to RGB,
        # because each color corresponds to a different instance
        # with 0 being background
        mask = Image.open(mask_path)
        # convert the PIL Image into a numpy array
        mask = np.array(mask)
        # instances are encoded as different colors
```

```
        obj_ids = np.unique(mask)
        # first id is the background, so remove it
        obj_ids = obj_ids[1:]

        # split the color-encoded mask into a set
        # of binary masks
        masks = mask == obj_ids[:, None, None]

        # get bounding box coordinates for each mask
        num_objs = len(obj_ids)
        boxes = []
        for i in range(num_objs):
            pos = np.where(masks[i])
            xmin = np.min(pos[1])
            xmax = np.max(pos[1])
            ymin = np.min(pos[0])
            ymax = np.max(pos[0])
            boxes.append([xmin, ymin, xmax, ymax])

        # convert everything into a torch.Tensor
        boxes = torch.as_tensor(boxes, dtype=torch.float32)
        # there is only one class
        labels = torch.ones((num_objs,), dtype=torch.int64)
        masks = torch.as_tensor(masks, dtype=torch.uint8)

        image_id = torch.tensor([idx])
        area = (boxes[:, 3] - boxes[:, 1]) * (boxes[:, 2] - boxes[:, 0])
        # suppose all instances are not crowd
        iscrowd = torch.zeros((num_objs,), dtype=torch.int64)

        target = {}
        target["boxes"] = boxes
        target["labels"] = labels
        target["masks"] = masks
        target["image_id"] = image_id
        target["area"] = area
        target["iscrowd"] = iscrowd

        if self.transforms is not None:
            img, target = self.transforms(img, target)

        return img, target

    def __len__(self):
        return len(self.imgs)
```

[2]:
```
import torchvision
import torchvision
from torchvision.models.detection import FasterRCNN
from torchvision.models.detection.rpn import AnchorGenerator
from torchvision.models.detection.faster_rcnn import FastRCNNPredictor
from torchvision.models.detection.mask_rcnn import MaskRCNNPredictor


def get_model_instance_segmentation_option1(num_classes):
    # load an instance segmentation model pre-trained pre-trained on COCO
    model = torchvision.models.detection.maskrcnn_resnet50_fpn(pretrained=True)

    # get number of input features for the classifier
    in_features = model.roi_heads.box_predictor.cls_score.in_features
    # replace the pre-trained head with a new one
    model.roi_heads.box_predictor = FastRCNNPredictor(in_features, num_classes)

    # now get the number of input features for the mask classifier
    in_features_mask = model.roi_heads.mask_predictor.conv5_mask.in_channels
    hidden_layer = 256
    # and replace the mask predictor with a new one
    model.roi_heads.mask_predictor = MaskRCNNPredictor(in_features_mask,
                                                       hidden_layer,
                                                       num_classes)

    return model


def get_model_instance_segmentation_option2(num_classes):

    # load a pre-trained model for classification and return
    # only the features
    backbone = torchvision.models.mobilenet_v2(weights="DEFAULT").features


    # FasterRCNN needs to know the number of
    # output channels in a backbone. For mobilenet_v2, it's 1280
    # so we need to add it here
    backbone.out_channels = 1280


    # let's make the RPN generate 5 x 3 anchors per spatial
    # location, with 5 different sizes and 3 different aspect
    # ratios. We have a Tuple[Tuple[int]] because each feature
    # map could potentially have different sizes and
    # aspect ratios
    anchor_generator = AnchorGenerator(sizes=((32, 64, 128, 256, 512),),
```

```
                                   aspect_ratios=((0.5, 1.0, 2.0),))


    # let's define what are the feature maps that we will
    # use to perform the region of interest cropping, as well as
    # the size of the crop after rescaling.
    # if your backbone returns a Tensor, featmap_names is expected to
    # be [0]. More generally, the backbone should return an
    # OrderedDict[Tensor], and in featmap_names you can choose which
    # feature maps to use.
    roi_pooler = torchvision.ops.MultiScaleRoIAlign(featmap_names=['0'],
                                                    output_size=7,
                                                    sampling_ratio=2)


   # put the pieces together inside a FasterRCNN model
    model = FasterRCNN(backbone,
                       num_classes=2,
                       rpn_anchor_generator=anchor_generator,
                       box_roi_pool=roi_pooler)

    return model
```

[3]:
```
import transforms as T

def get_transform(train):
    transforms = []
    transforms.append(T.PILToTensor())
    transforms.append(T.ConvertImageDtype(torch.float))
    if train:
        transforms.append(T.RandomHorizontalFlip(0.5))
    return T.Compose(transforms)
```

[4]:
```
from engine import train_one_epoch, evaluate
import utils
from PIL import Image
import torch
import torchvision.transforms as transforms
import requests
import utils
%matplotlib inline
import matplotlib.pyplot as plt

# train on the GPU or on the CPU, if a GPU is not available
device = torch.device('cuda') if torch.cuda.is_available() else torch.
 ↪device('cpu')
```

```
# our dataset has two classes only - background and person
num_classes = 2
# use our dataset and defined transformations
dataset = PennFudanDataset('PennFudanPed', get_transform(train=True))
dataset_test = PennFudanDataset('PennFudanPed', get_transform(train=False))

# split the dataset in train and test set
indices = torch.randperm(len(dataset)).tolist()
dataset = torch.utils.data.Subset(dataset, indices[:-50])
dataset_test = torch.utils.data.Subset(dataset_test, indices[-50:])

# define training and validation data loaders
data_loader = torch.utils.data.DataLoader(
    dataset, batch_size=2, shuffle=True, num_workers=0,
    collate_fn=utils.collate_fn)

data_loader_test = torch.utils.data.DataLoader(
    dataset_test, batch_size=1, shuffle=False, num_workers=0,
    collate_fn=utils.collate_fn)
```

[5]:
```
#MODEL_OPTION1
# get the model using our helper function
model_option1 = get_model_instance_segmentation_option1(num_classes)


# move model to the right device
model_option1.to(device)


# construct an optimizer for option1
params = [p for p in model_option1.parameters() if p.requires_grad]
optimizer = torch.optim.SGD(params, lr=0.005,
                            momentum=0.9, weight_decay=0.0005)
# and a learning rate scheduler for the same
lr_scheduler = torch.optim.lr_scheduler.StepLR(optimizer,
                                               step_size=3,
                                               gamma=0.1)


# let's train it for 10 epochs
num_epochs = 10

print ("MODEL OPTION 1")
for epoch in range(num_epochs):
    # train for one epoch, printing every 10 iterations
    train_one_epoch(model_option1, optimizer, data_loader, device, epoch,␣
 ↪print_freq=10)
```

```
    # update the learning rate
    lr_scheduler.step()
    # evaluate on the test dataset
    evaluate(model_option1, data_loader_test, device=device)

print ("\n")


print("That's it!")
```

```
C:\Users\DarkShepard\anaconda3\lib\site-
packages\torchvision\models\_utils.py:208: UserWarning: The parameter
'pretrained' is deprecated since 0.13 and may be removed in the future, please
use 'weights' instead.
  warnings.warn(
C:\Users\DarkShepard\anaconda3\lib\site-
packages\torchvision\models\_utils.py:223: UserWarning: Arguments other than a
weight enum or `None` for 'weights' are deprecated since 0.13 and may be removed
in the future. The current behavior is equivalent to passing
`weights=MaskRCNN_ResNet50_FPN_Weights.COCO_V1`. You can also use
`weights=MaskRCNN_ResNet50_FPN_Weights.DEFAULT` to get the most up-to-date
weights.
  warnings.warn(msg)

MODEL OPTION 1
Epoch: [0]  [ 0/60]  eta: 0:07:11  lr: 0.000090  loss: 5.9471 (5.9471)
loss_classifier: 0.7755 (0.7755)  loss_box_reg: 0.3824 (0.3824)  loss_mask:
4.7659 (4.7659)  loss_objectness: 0.0143 (0.0143)  loss_rpn_box_reg: 0.0089
(0.0089)  time: 7.1843  data: 0.0640  max mem: 2307
Epoch: [0]  [10/60]  eta: 0:00:52  lr: 0.000936  loss: 2.1655 (3.3392)
loss_classifier: 0.4531 (0.4821)  loss_box_reg: 0.3367 (0.3070)  loss_mask:
1.2532 (2.5236)  loss_objectness: 0.0163 (0.0218)  loss_rpn_box_reg: 0.0039
(0.0046)  time: 1.0480  data: 0.0300  max mem: 3221
Epoch: [0]  [20/60]  eta: 0:00:36  lr: 0.001783  loss: 1.0418 (2.1111)
loss_classifier: 0.2161 (0.3276)  loss_box_reg: 0.2687 (0.2740)  loss_mask:
0.4426 (1.4828)  loss_objectness: 0.0190 (0.0201)  loss_rpn_box_reg: 0.0055
(0.0067)  time: 0.6015  data: 0.0243  max mem: 3221
Epoch: [0]  [30/60]  eta: 0:00:25  lr: 0.002629  loss: 0.5561 (1.5960)
loss_classifier: 0.0829 (0.2492)  loss_box_reg: 0.2034 (0.2472)  loss_mask:
0.2642 (1.0763)  loss_objectness: 0.0101 (0.0167)  loss_rpn_box_reg: 0.0067
(0.0066)  time: 0.7266  data: 0.0236  max mem: 3314
Epoch: [0]  [40/60]  eta: 0:00:17  lr: 0.003476  loss: 0.4740 (1.3375)
loss_classifier: 0.0741 (0.2073)  loss_box_reg: 0.1685 (0.2422)  loss_mask:
0.2120 (0.8669)  loss_objectness: 0.0066 (0.0142)  loss_rpn_box_reg: 0.0060
(0.0068)  time: 0.7876  data: 0.0258  max mem: 3314
Epoch: [0]  [50/60]  eta: 0:00:07  lr: 0.004323  loss: 0.4759 (1.1735)
loss_classifier: 0.0700 (0.1793)  loss_box_reg: 0.2185 (0.2380)  loss_mask:
0.1858 (0.7370)  loss_objectness: 0.0039 (0.0123)  loss_rpn_box_reg: 0.0062
```

```
(0.0070)  time: 0.6582  data: 0.0257  max mem: 3314
Epoch: [0]  [59/60]  eta: 0:00:00  lr: 0.005000  loss: 0.3893 (1.0496)
loss_classifier: 0.0405 (0.1575)  loss_box_reg: 0.1553 (0.2215)  loss_mask:
0.1837 (0.6530)  loss_objectness: 0.0026 (0.0110)  loss_rpn_box_reg: 0.0044
(0.0065)  time: 0.7095  data: 0.0238  max mem: 3314
Epoch: [0] Total time: 0:00:48 (0.8129 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:10  model_time: 0.2008 (0.2008)  evaluator_time:
0.0080 (0.0080)  time: 0.2169  data: 0.0080  max mem: 3314
Test:  [49/50]  eta: 0:00:00  model_time: 0.0800 (0.0874)  evaluator_time:
0.0080 (0.0105)  time: 0.1075  data: 0.0116  max mem: 3314
Test: Total time: 0:00:05 (0.1115 s / it)
Averaged stats: model_time: 0.0800 (0.0874)  evaluator_time: 0.0080 (0.0105)
Accumulating evaluation results…
DONE (t=0.02s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.638
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.975
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.776
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.377
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.530
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.655
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.278
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.704
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.705
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.500
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.760
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.709
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.683
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.975
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.879
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.360
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.492
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.701
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.288
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.730
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.732
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.620
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.740
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.736
Epoch: [1]  [ 0/60]  eta: 0:00:24  lr: 0.005000  loss: 0.3453 (0.3453)
loss_classifier: 0.0389 (0.0389)  loss_box_reg: 0.1368 (0.1368)  loss_mask:
0.1588 (0.1588)  loss_objectness: 0.0047 (0.0047)  loss_rpn_box_reg: 0.0062
(0.0062)  time: 0.4004  data: 0.0160  max mem: 3314
```

```
Epoch: [1]  [10/60]  eta: 0:00:21  lr: 0.005000  loss: 0.3028 (0.3123)
loss_classifier: 0.0330 (0.0343)  loss_box_reg: 0.1156 (0.1212)  loss_mask:
0.1472 (0.1510)  loss_objectness: 0.0014 (0.0020)  loss_rpn_box_reg: 0.0036
(0.0039)  time: 0.4320  data: 0.0195  max mem: 3314
Epoch: [1]  [20/60]  eta: 0:00:16  lr: 0.005000  loss: 0.2579 (0.2921)
loss_classifier: 0.0262 (0.0335)  loss_box_reg: 0.0877 (0.1070)  loss_mask:
0.1413 (0.1451)  loss_objectness: 0.0014 (0.0026)  loss_rpn_box_reg: 0.0020
(0.0040)  time: 0.4245  data: 0.0200  max mem: 3314
Epoch: [1]  [30/60]  eta: 0:00:12  lr: 0.005000  loss: 0.2872 (0.3037)
loss_classifier: 0.0358 (0.0363)  loss_box_reg: 0.0839 (0.1061)  loss_mask:
0.1527 (0.1537)  loss_objectness: 0.0018 (0.0031)  loss_rpn_box_reg: 0.0027
(0.0044)  time: 0.4270  data: 0.0213  max mem: 3314
Epoch: [1]  [40/60]  eta: 0:00:08  lr: 0.005000  loss: 0.2872 (0.2950)
loss_classifier: 0.0384 (0.0367)  loss_box_reg: 0.0959 (0.1019)  loss_mask:
0.1527 (0.1490)  loss_objectness: 0.0009 (0.0027)  loss_rpn_box_reg: 0.0045
(0.0047)  time: 0.4436  data: 0.0226  max mem: 3314
Epoch: [1]  [50/60]  eta: 0:00:04  lr: 0.005000  loss: 0.2302 (0.2901)
loss_classifier: 0.0327 (0.0364)  loss_box_reg: 0.0770 (0.0988)  loss_mask:
0.1283 (0.1475)  loss_objectness: 0.0007 (0.0026)  loss_rpn_box_reg: 0.0035
(0.0048)  time: 0.4579  data: 0.0231  max mem: 3361
Epoch: [1]  [59/60]  eta: 0:00:00  lr: 0.005000  loss: 0.2525 (0.2920)
loss_classifier: 0.0358 (0.0369)  loss_box_reg: 0.0569 (0.0957)  loss_mask:
0.1305 (0.1522)  loss_objectness: 0.0005 (0.0024)  loss_rpn_box_reg: 0.0035
(0.0048)  time: 0.4526  data: 0.0211  max mem: 3361
Epoch: [1] Total time: 0:00:26 (0.4415 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:08  model_time: 0.1598 (0.1598)  evaluator_time:
0.0000 (0.0000)  time: 0.1678  data: 0.0080  max mem: 3361
Test:  [49/50]  eta: 0:00:00  model_time: 0.0800 (0.0822)  evaluator_time:
0.0080 (0.0053)  time: 0.0975  data: 0.0096  max mem: 3361
Test: Total time: 0:00:04 (0.0989 s / it)
Averaged stats: model_time: 0.0800 (0.0822)  evaluator_time: 0.0080 (0.0053)
Accumulating evaluation results…
DONE (t=0.01s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.784
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.974
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.930
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.413
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.654
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.810
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.337
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.838
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.838
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
```

```
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.770
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.858
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.735
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.974
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.937
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.402
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.524
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.760
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.314
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.780
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.780
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.740
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.795
Epoch: [2]  [ 0/60]  eta: 0:00:31  lr: 0.005000  loss: 0.2300 (0.2300)
loss_classifier: 0.0226 (0.0226)  loss_box_reg: 0.0595 (0.0595)  loss_mask:
0.1433 (0.1433)  loss_objectness: 0.0002 (0.0002)  loss_rpn_box_reg: 0.0043
(0.0043)  time: 0.5206  data: 0.0240  max mem: 3361
Epoch: [2]  [10/60]  eta: 0:00:21  lr: 0.005000  loss: 0.2300 (0.2261)
loss_classifier: 0.0252 (0.0269)  loss_box_reg: 0.0578 (0.0534)  loss_mask:
0.1235 (0.1418)  loss_objectness: 0.0002 (0.0007)  loss_rpn_box_reg: 0.0029
(0.0033)  time: 0.4268  data: 0.0215  max mem: 3361
Epoch: [2]  [20/60]  eta: 0:00:17  lr: 0.005000  loss: 0.2272 (0.2346)
loss_classifier: 0.0312 (0.0312)  loss_box_reg: 0.0527 (0.0593)  loss_mask:
0.1249 (0.1396)  loss_objectness: 0.0009 (0.0015)  loss_rpn_box_reg: 0.0027
(0.0030)  time: 0.4285  data: 0.0231  max mem: 3361
Epoch: [2]  [30/60]  eta: 0:00:13  lr: 0.005000  loss: 0.2426 (0.2390)
loss_classifier: 0.0330 (0.0335)  loss_box_reg: 0.0630 (0.0649)  loss_mask:
0.1249 (0.1359)  loss_objectness: 0.0009 (0.0013)  loss_rpn_box_reg: 0.0034
(0.0034)  time: 0.4428  data: 0.0253  max mem: 3361
Epoch: [2]  [40/60]  eta: 0:00:08  lr: 0.005000  loss: 0.2426 (0.2353)
loss_classifier: 0.0318 (0.0333)  loss_box_reg: 0.0650 (0.0643)  loss_mask:
0.1186 (0.1327)  loss_objectness: 0.0006 (0.0013)  loss_rpn_box_reg: 0.0036
(0.0036)  time: 0.4592  data: 0.0233  max mem: 3361
Epoch: [2]  [50/60]  eta: 0:00:04  lr: 0.005000  loss: 0.2035 (0.2343)
loss_classifier: 0.0268 (0.0322)  loss_box_reg: 0.0570 (0.0636)  loss_mask:
0.1186 (0.1334)  loss_objectness: 0.0005 (0.0012)  loss_rpn_box_reg: 0.0031
(0.0039)  time: 0.4631  data: 0.0213  max mem: 3361
Epoch: [2]  [59/60]  eta: 0:00:00  lr: 0.005000  loss: 0.1915 (0.2335)
loss_classifier: 0.0240 (0.0321)  loss_box_reg: 0.0503 (0.0645)  loss_mask:
0.1187 (0.1315)  loss_objectness: 0.0014 (0.0014)  loss_rpn_box_reg: 0.0021
(0.0039)  time: 0.4546  data: 0.0221  max mem: 3361
Epoch: [2] Total time: 0:00:27 (0.4501 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:10  model_time: 0.1954 (0.1954)  evaluator_time:
0.0000 (0.0000)  time: 0.2108  data: 0.0154  max mem: 3361
```

```
Test:  [49/50]  eta: 0:00:00  model_time: 0.0802 (0.0833)  evaluator_time:
0.0000 (0.0050)  time: 0.0980  data: 0.0116  max mem: 3361
Test: Total time: 0:00:05 (0.1008 s / it)
Averaged stats: model_time: 0.0802 (0.0833)  evaluator_time: 0.0000 (0.0050)
Accumulating evaluation results…
DONE (t=0.01s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.754
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.977
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.904
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.434
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.587
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.777
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.328
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.803
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.803
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.720
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.822
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.753
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.977
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.889
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.412
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.591
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.776
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.326
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.795
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.795
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.750
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.810
Epoch: [3]  [ 0/60]  eta: 0:00:26  lr: 0.000500  loss: 0.2212 (0.2212)
loss_classifier: 0.0372 (0.0372)  loss_box_reg: 0.0561 (0.0561)  loss_mask:
0.1228 (0.1228)  loss_objectness: 0.0033 (0.0033)  loss_rpn_box_reg: 0.0019
(0.0019)  time: 0.4489  data: 0.0161  max mem: 3361
Epoch: [3]  [10/60]  eta: 0:00:21  lr: 0.000500  loss: 0.1945 (0.2000)
loss_classifier: 0.0261 (0.0260)  loss_box_reg: 0.0490 (0.0477)  loss_mask:
0.1228 (0.1233)  loss_objectness: 0.0005 (0.0009)  loss_rpn_box_reg: 0.0014
(0.0021)  time: 0.4266  data: 0.0209  max mem: 3361
Epoch: [3]  [20/60]  eta: 0:00:18  lr: 0.000500  loss: 0.1905 (0.1935)
loss_classifier: 0.0254 (0.0256)  loss_box_reg: 0.0418 (0.0447)  loss_mask:
0.1177 (0.1195)  loss_objectness: 0.0006 (0.0011)  loss_rpn_box_reg: 0.0018
(0.0026)  time: 0.4510  data: 0.0221  max mem: 3361
Epoch: [3]  [30/60]  eta: 0:00:13  lr: 0.000500  loss: 0.1797 (0.1960)
loss_classifier: 0.0199 (0.0257)  loss_box_reg: 0.0339 (0.0439)  loss_mask:
```

```
0.1127 (0.1225)  loss_objectness: 0.0005 (0.0011)  loss_rpn_box_reg: 0.0027
(0.0028)  time: 0.4629  data: 0.0236  max mem: 3361
Epoch: [3]  [40/60]  eta: 0:00:08  lr: 0.000500  loss: 0.1716 (0.1961)
loss_classifier: 0.0189 (0.0250)  loss_box_reg: 0.0299 (0.0432)  loss_mask:
0.1171 (0.1238)  loss_objectness: 0.0004 (0.0011)  loss_rpn_box_reg: 0.0024
(0.0030)  time: 0.4449  data: 0.0243  max mem: 3361
Epoch: [3]  [50/60]  eta: 0:00:04  lr: 0.000500  loss: 0.1897 (0.1979)
loss_classifier: 0.0225 (0.0259)  loss_box_reg: 0.0370 (0.0439)  loss_mask:
0.1171 (0.1239)  loss_objectness: 0.0008 (0.0012)  loss_rpn_box_reg: 0.0024
(0.0030)  time: 0.4411  data: 0.0244  max mem: 3361
Epoch: [3]  [59/60]  eta: 0:00:00  lr: 0.000500  loss: 0.1733 (0.1944)
loss_classifier: 0.0246 (0.0257)  loss_box_reg: 0.0373 (0.0435)  loss_mask:
0.1082 (0.1211)  loss_objectness: 0.0006 (0.0011)  loss_rpn_box_reg: 0.0021
(0.0029)  time: 0.4472  data: 0.0260  max mem: 3361
Epoch: [3] Total time: 0:00:26 (0.4483 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:10  model_time: 0.2081 (0.2081)  evaluator_time:
0.0000 (0.0000)  time: 0.2163  data: 0.0082  max mem: 3361
Test:  [49/50]  eta: 0:00:00  model_time: 0.0800 (0.0829)  evaluator_time:
0.0080 (0.0039)  time: 0.0958  data: 0.0115  max mem: 3361
Test: Total time: 0:00:04 (0.1000 s / it)
Averaged stats: model_time: 0.0800 (0.0829)  evaluator_time: 0.0080 (0.0039)
Accumulating evaluation results…
DONE (t=0.01s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.795
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.977
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.910
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.512
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.643
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.821
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.348
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.842
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.842
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.750
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.863
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.761
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.977
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.896
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.412
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.564
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.784
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.328
```

```
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.800
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.800
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.760
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.816
Epoch: [4]  [ 0/60]  eta: 0:00:24  lr: 0.000500  loss: 0.2595 (0.2595)
loss_classifier: 0.0281 (0.0281)  loss_box_reg: 0.0540 (0.0540)  loss_mask:
0.1696 (0.1696)  loss_objectness: 0.0013 (0.0013)  loss_rpn_box_reg: 0.0065
(0.0065)  time: 0.4087  data: 0.0240  max mem: 3361
Epoch: [4]  [10/60]  eta: 0:00:22  lr: 0.000500  loss: 0.1828 (0.1864)
loss_classifier: 0.0273 (0.0257)  loss_box_reg: 0.0363 (0.0387)  loss_mask:
0.1162 (0.1179)  loss_objectness: 0.0009 (0.0011)  loss_rpn_box_reg: 0.0023
(0.0030)  time: 0.4575  data: 0.0220  max mem: 3361
Epoch: [4]  [20/60]  eta: 0:00:18  lr: 0.000500  loss: 0.1828 (0.1953)
loss_classifier: 0.0273 (0.0275)  loss_box_reg: 0.0402 (0.0423)  loss_mask:
0.1162 (0.1215)  loss_objectness: 0.0006 (0.0010)  loss_rpn_box_reg: 0.0023
(0.0030)  time: 0.4677  data: 0.0222  max mem: 3361
Epoch: [4]  [30/60]  eta: 0:00:18  lr: 0.000500  loss: 0.1816 (0.1859)
loss_classifier: 0.0241 (0.0251)  loss_box_reg: 0.0402 (0.0390)  loss_mask:
0.1100 (0.1179)  loss_objectness: 0.0003 (0.0009)  loss_rpn_box_reg: 0.0018
(0.0029)  time: 0.6940  data: 0.0253  max mem: 3361
Epoch: [4]  [40/60]  eta: 0:00:11  lr: 0.000500  loss: 0.1790 (0.1848)
loss_classifier: 0.0241 (0.0249)  loss_box_reg: 0.0257 (0.0382)  loss_mask:
0.1100 (0.1179)  loss_objectness: 0.0003 (0.0011)  loss_rpn_box_reg: 0.0017
(0.0027)  time: 0.6632  data: 0.0245  max mem: 3361
Epoch: [4]  [50/60]  eta: 0:00:05  lr: 0.000500  loss: 0.1790 (0.1924)
loss_classifier: 0.0260 (0.0264)  loss_box_reg: 0.0330 (0.0405)  loss_mask:
0.1155 (0.1217)  loss_objectness: 0.0004 (0.0010)  loss_rpn_box_reg: 0.0023
(0.0029)  time: 0.4446  data: 0.0243  max mem: 3361
Epoch: [4]  [59/60]  eta: 0:00:00  lr: 0.000500  loss: 0.1693 (0.1878)
loss_classifier: 0.0254 (0.0251)  loss_box_reg: 0.0324 (0.0387)  loss_mask:
0.1118 (0.1202)  loss_objectness: 0.0004 (0.0011)  loss_rpn_box_reg: 0.0020
(0.0027)  time: 0.4427  data: 0.0224  max mem: 3361
Epoch: [4] Total time: 0:00:31 (0.5248 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:10  model_time: 0.2097 (0.2097)  evaluator_time:
0.0000 (0.0000)  time: 0.2177  data: 0.0080  max mem: 3361
Test:  [49/50]  eta: 0:00:00  model_time: 0.0802 (0.0814)  evaluator_time:
0.0000 (0.0044)  time: 0.0963  data: 0.0099  max mem: 3361
Test: Total time: 0:00:04 (0.0987 s / it)
Averaged stats: model_time: 0.0802 (0.0814)  evaluator_time: 0.0000 (0.0044)
Accumulating evaluation results…
DONE (t=0.00s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.808
```

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 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.927
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.524
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.669
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.832
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.353
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.857
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.857
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.560
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.820
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.873
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.760
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.897
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.422
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.505
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.782
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.326
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.802
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.802
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.780
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.815
Epoch: [5]  [ 0/60]  eta: 0:00:26  lr: 0.000500  loss: 0.2048 (0.2048)
loss_classifier: 0.0308 (0.0308)  loss_box_reg: 0.0460 (0.0460)  loss_mask:
0.1258 (0.1258)  loss_objectness: 0.0001 (0.0001)  loss_rpn_box_reg: 0.0021
(0.0021)  time: 0.4456  data: 0.0241  max mem: 3361
Epoch: [5]  [10/60]  eta: 0:00:42  lr: 0.000500  loss: 0.2048 (0.2041)
loss_classifier: 0.0289 (0.0285)  loss_box_reg: 0.0460 (0.0474)  loss_mask:
0.1203 (0.1239)  loss_objectness: 0.0006 (0.0016)  loss_rpn_box_reg: 0.0023
(0.0027)  time: 0.8531  data: 0.0276  max mem: 3361
Epoch: [5]  [20/60]  eta: 0:00:40  lr: 0.000500  loss: 0.1889 (0.2018)
loss_classifier: 0.0266 (0.0270)  loss_box_reg: 0.0404 (0.0448)  loss_mask:
0.1185 (0.1263)  loss_objectness: 0.0005 (0.0010)  loss_rpn_box_reg: 0.0023
(0.0027)  time: 1.0374  data: 0.0277  max mem: 3361
Epoch: [5]  [30/60]  eta: 0:00:24  lr: 0.000500  loss: 0.1602 (0.1909)
loss_classifier: 0.0231 (0.0270)  loss_box_reg: 0.0273 (0.0411)  loss_mask:
0.1101 (0.1195)  loss_objectness: 0.0003 (0.0009)  loss_rpn_box_reg: 0.0016
(0.0024)  time: 0.8074  data: 0.0243  max mem: 3361
Epoch: [5]  [40/60]  eta: 0:00:14  lr: 0.000500  loss: 0.1581 (0.1868)
loss_classifier: 0.0231 (0.0261)  loss_box_reg: 0.0297 (0.0390)  loss_mask:
0.1062 (0.1182)  loss_objectness: 0.0005 (0.0010)  loss_rpn_box_reg: 0.0020
(0.0025)  time: 0.4423  data: 0.0227  max mem: 3361
Epoch: [5]  [50/60]  eta: 0:00:06  lr: 0.000500  loss: 0.1751 (0.1882)
loss_classifier: 0.0254 (0.0260)  loss_box_reg: 0.0356 (0.0394)  loss_mask:
0.1141 (0.1194)  loss_objectness: 0.0005 (0.0009)  loss_rpn_box_reg: 0.0023
(0.0026)  time: 0.4536  data: 0.0235  max mem: 3361
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Epoch: [5]  [59/60]  eta: 0:00:00  lr: 0.000500  loss: 0.1594 (0.1837)
loss_classifier: 0.0240 (0.0253)  loss_box_reg: 0.0345 (0.0379)  loss_mask:
0.1049 (0.1171)  loss_objectness: 0.0004 (0.0009)  loss_rpn_box_reg: 0.0019
(0.0025)  time: 0.4479  data: 0.0233  max mem: 3361
Epoch: [5] Total time: 0:00:38 (0.6432 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:09  model_time: 0.1703 (0.1703)  evaluator_time:
0.0000 (0.0000)  time: 0.1813  data: 0.0110  max mem: 3361
Test:  [49/50]  eta: 0:00:00  model_time: 0.0797 (0.0817)  evaluator_time:
0.0000 (0.0041)  time: 0.0961  data: 0.0114  max mem: 3361
Test: Total time: 0:00:04 (0.0982 s / it)
Averaged stats: model_time: 0.0797 (0.0817)  evaluator_time: 0.0000 (0.0041)
Accumulating evaluation results…
DONE (t=0.01s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.799
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.975
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.927
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.519
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.649
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.823
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.347
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.848
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.848
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.790
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.866
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.764
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.975
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.898
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.422
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.548
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.787
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.327
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.805
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.805
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.780
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.818
Epoch: [6]  [ 0/60]  eta: 0:00:29  lr: 0.000050  loss: 0.2431 (0.2431)
loss_classifier: 0.0321 (0.0321)  loss_box_reg: 0.0515 (0.0515)  loss_mask:
0.1530 (0.1530)  loss_objectness: 0.0014 (0.0014)  loss_rpn_box_reg: 0.0050
(0.0050)  time: 0.4917  data: 0.0324  max mem: 3361
Epoch: [6]  [10/60]  eta: 0:00:23  lr: 0.000050  loss: 0.1645 (0.1959)
```

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loss_classifier: 0.0287 (0.0302)  loss_box_reg: 0.0290 (0.0427)  loss_mask:
0.1225 (0.1195)  loss_objectness: 0.0004 (0.0008)  loss_rpn_box_reg: 0.0014
(0.0028)  time: 0.4713  data: 0.0284  max mem: 3361
Epoch: [6]  [20/60]  eta: 0:00:18  lr: 0.000050  loss: 0.1578 (0.1801)
loss_classifier: 0.0207 (0.0258)  loss_box_reg: 0.0290 (0.0377)  loss_mask:
0.1054 (0.1131)  loss_objectness: 0.0004 (0.0007)  loss_rpn_box_reg: 0.0014
(0.0028)  time: 0.4573  data: 0.0258  max mem: 3361
Epoch: [6]  [30/60]  eta: 0:00:13  lr: 0.000050  loss: 0.1582 (0.1773)
loss_classifier: 0.0162 (0.0251)  loss_box_reg: 0.0317 (0.0362)  loss_mask:
0.1054 (0.1128)  loss_objectness: 0.0004 (0.0007)  loss_rpn_box_reg: 0.0011
(0.0025)  time: 0.4460  data: 0.0227  max mem: 3361
Epoch: [6]  [40/60]  eta: 0:00:08  lr: 0.000050  loss: 0.1749 (0.1802)
loss_classifier: 0.0257 (0.0248)  loss_box_reg: 0.0328 (0.0369)  loss_mask:
0.1068 (0.1151)  loss_objectness: 0.0006 (0.0008)  loss_rpn_box_reg: 0.0019
(0.0025)  time: 0.4332  data: 0.0214  max mem: 3361
Epoch: [6]  [50/60]  eta: 0:00:04  lr: 0.000050  loss: 0.1786 (0.1797)
loss_classifier: 0.0265 (0.0250)  loss_box_reg: 0.0325 (0.0367)  loss_mask:
0.1068 (0.1147)  loss_objectness: 0.0006 (0.0008)  loss_rpn_box_reg: 0.0021
(0.0025)  time: 0.4320  data: 0.0226  max mem: 3361
Epoch: [6]  [59/60]  eta: 0:00:00  lr: 0.000050  loss: 0.1740 (0.1799)
loss_classifier: 0.0242 (0.0249)  loss_box_reg: 0.0325 (0.0370)  loss_mask:
0.1076 (0.1147)  loss_objectness: 0.0003 (0.0008)  loss_rpn_box_reg: 0.0017
(0.0025)  time: 0.4465  data: 0.0253  max mem: 3361
Epoch: [6] Total time: 0:00:26 (0.4476 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:09  model_time: 0.1701 (0.1701)  evaluator_time:
0.0080 (0.0080)  time: 0.1857  data: 0.0075  max mem: 3361
Test:  [49/50]  eta: 0:00:00  model_time: 0.0805 (0.0828)  evaluator_time:
0.0065 (0.0055)  time: 0.0988  data: 0.0110  max mem: 3361
Test: Total time: 0:00:05 (0.1013 s / it)
Averaged stats: model_time: 0.0805 (0.0828)  evaluator_time: 0.0065 (0.0055)
Accumulating evaluation results…
DONE (t=0.01s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.806
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.928
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.519
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.663
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.830
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.350
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.855
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.855
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.800
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 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.873
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.758
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.898
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.412
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.545
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.782
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.325
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.800
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.800
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.770
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.815
Epoch: [7]  [ 0/60]  eta: 0:00:25  lr: 0.000050  loss: 0.1644 (0.1644)
loss_classifier: 0.0238 (0.0238)  loss_box_reg: 0.0247 (0.0247)  loss_mask:
0.1133 (0.1133)  loss_objectness: 0.0002 (0.0002)  loss_rpn_box_reg: 0.0024
(0.0024)  time: 0.4238  data: 0.0242  max mem: 3361
Epoch: [7]  [10/60]  eta: 0:00:23  lr: 0.000050  loss: 0.2035 (0.2035)
loss_classifier: 0.0283 (0.0314)  loss_box_reg: 0.0464 (0.0474)  loss_mask:
0.1154 (0.1203)  loss_objectness: 0.0002 (0.0006)  loss_rpn_box_reg: 0.0027
(0.0038)  time: 0.4702  data: 0.0277  max mem: 3361
Epoch: [7]  [20/60]  eta: 0:00:18  lr: 0.000050  loss: 0.1951 (0.1964)
loss_classifier: 0.0257 (0.0289)  loss_box_reg: 0.0409 (0.0435)  loss_mask:
0.1154 (0.1194)  loss_objectness: 0.0005 (0.0010)  loss_rpn_box_reg: 0.0027
(0.0036)  time: 0.4680  data: 0.0263  max mem: 3361
Epoch: [7]  [30/60]  eta: 0:00:13  lr: 0.000050  loss: 0.1610 (0.1831)
loss_classifier: 0.0196 (0.0262)  loss_box_reg: 0.0270 (0.0376)  loss_mask:
0.1094 (0.1155)  loss_objectness: 0.0003 (0.0009)  loss_rpn_box_reg: 0.0016
(0.0029)  time: 0.4504  data: 0.0253  max mem: 3361
Epoch: [7]  [40/60]  eta: 0:00:08  lr: 0.000050  loss: 0.1580 (0.1821)
loss_classifier: 0.0196 (0.0251)  loss_box_reg: 0.0242 (0.0360)  loss_mask:
0.1094 (0.1174)  loss_objectness: 0.0004 (0.0008)  loss_rpn_box_reg: 0.0012
(0.0029)  time: 0.4316  data: 0.0230  max mem: 3361
Epoch: [7]  [50/60]  eta: 0:00:04  lr: 0.000050  loss: 0.1580 (0.1805)
loss_classifier: 0.0189 (0.0249)  loss_box_reg: 0.0248 (0.0358)  loss_mask:
0.1054 (0.1163)  loss_objectness: 0.0004 (0.0008)  loss_rpn_box_reg: 0.0016
(0.0027)  time: 0.4332  data: 0.0221  max mem: 3361
Epoch: [7]  [59/60]  eta: 0:00:00  lr: 0.000050  loss: 0.1692 (0.1795)
loss_classifier: 0.0215 (0.0251)  loss_box_reg: 0.0263 (0.0356)  loss_mask:
0.1043 (0.1154)  loss_objectness: 0.0004 (0.0008)  loss_rpn_box_reg: 0.0016
(0.0026)  time: 0.4400  data: 0.0211  max mem: 3361
Epoch: [7] Total time: 0:00:26 (0.4471 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:09  model_time: 0.1851 (0.1851)  evaluator_time:
0.0000 (0.0000)  time: 0.1937  data: 0.0085  max mem: 3361
Test:  [49/50]  eta: 0:00:00  model_time: 0.0801 (0.0823)  evaluator_time:
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0.0077 (0.0046)  time: 0.0954  data: 0.0107  max mem: 3361
Test: Total time: 0:00:04 (0.0993 s / it)
Averaged stats: model_time: 0.0801 (0.0823)  evaluator_time: 0.0077 (0.0046)
Accumulating evaluation results…
DONE (t=0.01s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.804
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.928
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.519
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.656
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.830
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.350
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.855
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.855
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.790
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.874
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.761
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.898
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.412
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.545
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.785
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.328
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.803
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.803
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.770
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.818
Epoch: [8]  [ 0/60]  eta: 0:00:25  lr: 0.000050  loss: 0.1954 (0.1954)
loss_classifier: 0.0225 (0.0225)  loss_box_reg: 0.0391 (0.0391)  loss_mask:
0.1312 (0.1312)  loss_objectness: 0.0001 (0.0001)  loss_rpn_box_reg: 0.0024
(0.0024)  time: 0.4222  data: 0.0160  max mem: 3361
Epoch: [8]  [10/60]  eta: 0:00:22  lr: 0.000050  loss: 0.1656 (0.1653)
loss_classifier: 0.0233 (0.0258)  loss_box_reg: 0.0254 (0.0298)  loss_mask:
0.1059 (0.1072)  loss_objectness: 0.0003 (0.0009)  loss_rpn_box_reg: 0.0011
(0.0016)  time: 0.4492  data: 0.0220  max mem: 3361
Epoch: [8]  [20/60]  eta: 0:00:17  lr: 0.000050  loss: 0.1481 (0.1650)
loss_classifier: 0.0166 (0.0224)  loss_box_reg: 0.0219 (0.0289)  loss_mask:
0.1084 (0.1111)  loss_objectness: 0.0002 (0.0008)  loss_rpn_box_reg: 0.0013
(0.0018)  time: 0.4406  data: 0.0226  max mem: 3361
Epoch: [8]  [30/60]  eta: 0:00:13  lr: 0.000050  loss: 0.1667 (0.1745)
loss_classifier: 0.0166 (0.0220)  loss_box_reg: 0.0284 (0.0326)  loss_mask:
0.1138 (0.1166)  loss_objectness: 0.0004 (0.0009)  loss_rpn_box_reg: 0.0024
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(0.0025)  time: 0.4384  data: 0.0224  max mem: 3361
Epoch: [8]  [40/60]  eta: 0:00:08  lr: 0.000050  loss: 0.1786 (0.1738)
loss_classifier: 0.0194 (0.0221)  loss_box_reg: 0.0303 (0.0319)  loss_mask:
0.1152 (0.1165)  loss_objectness: 0.0004 (0.0009)  loss_rpn_box_reg: 0.0019
(0.0024)  time: 0.4551  data: 0.0208  max mem: 3636
Epoch: [8]  [50/60]  eta: 0:00:04  lr: 0.000050  loss: 0.1768 (0.1774)
loss_classifier: 0.0227 (0.0228)  loss_box_reg: 0.0365 (0.0337)  loss_mask:
0.1113 (0.1176)  loss_objectness: 0.0004 (0.0008)  loss_rpn_box_reg: 0.0016
(0.0024)  time: 0.4556  data: 0.0218  max mem: 3636
Epoch: [8]  [59/60]  eta: 0:00:00  lr: 0.000050  loss: 0.1899 (0.1789)
loss_classifier: 0.0232 (0.0243)  loss_box_reg: 0.0409 (0.0351)  loss_mask:
0.1112 (0.1161)  loss_objectness: 0.0003 (0.0008)  loss_rpn_box_reg: 0.0022
(0.0026)  time: 0.4515  data: 0.0225  max mem: 3636
Epoch: [8] Total time: 0:00:26 (0.4499 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:10  model_time: 0.1922 (0.1922)  evaluator_time:
0.0000 (0.0000)  time: 0.2006  data: 0.0085  max mem: 3636
Test:  [49/50]  eta: 0:00:00  model_time: 0.0808 (0.0833)  evaluator_time:
0.0040 (0.0036)  time: 0.0983  data: 0.0118  max mem: 3636
Test: Total time: 0:00:04 (0.0992 s / it)
Averaged stats: model_time: 0.0808 (0.0833)  evaluator_time: 0.0040 (0.0036)
Accumulating evaluation results…
DONE (t=0.01s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.806
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.928
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.519
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.656
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.831
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.350
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.856
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.856
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.790
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.876
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.760
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.898
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.412
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.545
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.783
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.326
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.800
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 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.800
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.770
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.815
Epoch: [9]  [ 0/60]  eta: 0:00:27  lr: 0.000005  loss: 0.1710 (0.1710)
loss_classifier: 0.0095 (0.0095)  loss_box_reg: 0.0210 (0.0210)  loss_mask:
0.1392 (0.1392)  loss_objectness: 0.0003 (0.0003)  loss_rpn_box_reg: 0.0011
(0.0011)  time: 0.4534  data: 0.0212  max mem: 3636
Epoch: [9]  [10/60]  eta: 0:00:23  lr: 0.000005  loss: 0.1688 (0.1818)
loss_classifier: 0.0232 (0.0254)  loss_box_reg: 0.0227 (0.0369)  loss_mask:
0.1068 (0.1162)  loss_objectness: 0.0005 (0.0008)  loss_rpn_box_reg: 0.0022
(0.0024)  time: 0.4607  data: 0.0246  max mem: 3636
Epoch: [9]  [20/60]  eta: 0:00:18  lr: 0.000005  loss: 0.1508 (0.1756)
loss_classifier: 0.0229 (0.0252)  loss_box_reg: 0.0227 (0.0356)  loss_mask:
0.1067 (0.1119)  loss_objectness: 0.0004 (0.0008)  loss_rpn_box_reg: 0.0020
(0.0022)  time: 0.4529  data: 0.0229  max mem: 3636
Epoch: [9]  [30/60]  eta: 0:00:13  lr: 0.000005  loss: 0.1508 (0.1799)
loss_classifier: 0.0177 (0.0252)  loss_box_reg: 0.0282 (0.0368)  loss_mask:
0.1094 (0.1147)  loss_objectness: 0.0004 (0.0007)  loss_rpn_box_reg: 0.0019
(0.0025)  time: 0.4564  data: 0.0233  max mem: 3636
Epoch: [9]  [40/60]  eta: 0:00:09  lr: 0.000005  loss: 0.1724 (0.1822)
loss_classifier: 0.0240 (0.0261)  loss_box_reg: 0.0325 (0.0373)  loss_mask:
0.1155 (0.1156)  loss_objectness: 0.0007 (0.0008)  loss_rpn_box_reg: 0.0021
(0.0025)  time: 0.4756  data: 0.0281  max mem: 3636
Epoch: [9]  [50/60]  eta: 0:00:04  lr: 0.000005  loss: 0.1733 (0.1824)
loss_classifier: 0.0240 (0.0255)  loss_box_reg: 0.0310 (0.0369)  loss_mask:
0.1122 (0.1166)  loss_objectness: 0.0006 (0.0008)  loss_rpn_box_reg: 0.0022
(0.0025)  time: 0.4643  data: 0.0265  max mem: 3636
Epoch: [9]  [59/60]  eta: 0:00:00  lr: 0.000005  loss: 0.1555 (0.1776)
loss_classifier: 0.0164 (0.0245)  loss_box_reg: 0.0242 (0.0353)  loss_mask:
0.1028 (0.1145)  loss_objectness: 0.0003 (0.0008)  loss_rpn_box_reg: 0.0016
(0.0024)  time: 0.4276  data: 0.0208  max mem: 3636
Epoch: [9] Total time: 0:00:27 (0.4526 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:10  model_time: 0.2094 (0.2094)  evaluator_time:
0.0000 (0.0000)  time: 0.2094  data: 0.0000  max mem: 3636
Test:  [49/50]  eta: 0:00:00  model_time: 0.0801 (0.0810)  evaluator_time:
0.0010 (0.0049)  time: 0.0949  data: 0.0104  max mem: 3636
Test: Total time: 0:00:04 (0.0983 s / it)
Averaged stats: model_time: 0.0801 (0.0810)  evaluator_time: 0.0010 (0.0049)
Accumulating evaluation results…
DONE (t=0.00s).
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.806
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
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 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.928
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.519
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.656
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.830
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.351
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.856
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.856
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.540
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.790
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.876
IoU metric: segm
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.760
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.976
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.898
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.412
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.545
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.783
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.326
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.801
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.801
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.520
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.770
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.816
```

That's it!

[6]:
```
model_option2 = get_model_instance_segmentation_option2(num_classes)
model_option2.to(device)
# construct an optimizer for option2
params = [p for p in model_option2.parameters() if p.requires_grad]
optimizer = torch.optim.SGD(params, lr=0.005,
                            momentum=0.9, weight_decay=0.0005)
# and a learning rate scheduler for the same
lr_scheduler = torch.optim.lr_scheduler.StepLR(optimizer,
                                               step_size=3,
                                               gamma=0.1)

print ("MODEL OPTION 2")
for epoch in range(num_epochs):
    # train for one epoch, printing every 10 iterations
    train_one_epoch(model_option2, optimizer, data_loader, device, epoch,␣
 ↪print_freq=10)
    # update the learning rate
    lr_scheduler.step()
    # evaluate on the test dataset
    evaluate(model_option2, data_loader_test, device=device)
```

```
print("That's it!")
```

```
MODEL OPTION 2
Epoch: [0]  [ 0/60]  eta: 0:00:27  lr: 0.000090  loss: 1.5713 (1.5713)
loss_classifier: 0.7023 (0.7023)  loss_box_reg: 0.1069 (0.1069)
loss_objectness: 0.7025 (0.7025)  loss_rpn_box_reg: 0.0595 (0.0595)  time:
0.4655  data: 0.0212  max mem: 4086
Epoch: [0]  [10/60]  eta: 0:00:17  lr: 0.000936  loss: 1.4756 (1.4343)
loss_classifier: 0.6525 (0.6258)  loss_box_reg: 0.0713 (0.0771)
loss_objectness: 0.6990 (0.6929)  loss_rpn_box_reg: 0.0386 (0.0385)  time:
0.3403  data: 0.0206  max mem: 5034
Epoch: [0]  [20/60]  eta: 0:00:13  lr: 0.001783  loss: 1.2596 (1.2719)
loss_classifier: 0.4106 (0.4682)  loss_box_reg: 0.0810 (0.1061)
loss_objectness: 0.6601 (0.6522)  loss_rpn_box_reg: 0.0385 (0.0454)  time:
0.3389  data: 0.0222  max mem: 5505
Epoch: [0]  [30/60]  eta: 0:00:10  lr: 0.002629  loss: 1.0127 (1.1652)
loss_classifier: 0.2748 (0.4080)  loss_box_reg: 0.1583 (0.1293)
loss_objectness: 0.5254 (0.5864)  loss_rpn_box_reg: 0.0336 (0.0415)  time:
0.3404  data: 0.0233  max mem: 5505
Epoch: [0]  [40/60]  eta: 0:00:06  lr: 0.003476  loss: 0.8115 (1.0779)
loss_classifier: 0.2554 (0.3734)  loss_box_reg: 0.1632 (0.1407)
loss_objectness: 0.3789 (0.5221)  loss_rpn_box_reg: 0.0336 (0.0417)  time:
0.3294  data: 0.0229  max mem: 5505
Epoch: [0]  [50/60]  eta: 0:00:03  lr: 0.004323  loss: 0.6394 (0.9905)
loss_classifier: 0.2259 (0.3429)  loss_box_reg: 0.1464 (0.1426)
loss_objectness: 0.2805 (0.4653)  loss_rpn_box_reg: 0.0386 (0.0396)  time:
0.3302  data: 0.0220  max mem: 5505
Epoch: [0]  [59/60]  eta: 0:00:00  lr: 0.005000  loss: 0.6360 (0.9436)
loss_classifier: 0.2259 (0.3265)  loss_box_reg: 0.1749 (0.1532)
loss_objectness: 0.2073 (0.4257)  loss_rpn_box_reg: 0.0275 (0.0383)  time:
0.3455  data: 0.0235  max mem: 6148
Epoch: [0] Total time: 0:00:20 (0.3404 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:04  model_time: 0.0700 (0.0700)  evaluator_time:
0.0000 (0.0000)  time: 0.0857  data: 0.0156  max mem: 6148
Test:  [49/50]  eta: 0:00:00  model_time: 0.0313 (0.0326)  evaluator_time:
0.0000 (0.0030)  time: 0.0473  data: 0.0121  max mem: 6148
Test: Total time: 0:00:02 (0.0480 s / it)
Averaged stats: model_time: 0.0313 (0.0326)  evaluator_time: 0.0000 (0.0030)
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.036
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.130
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.003
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
```

```
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.093
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.044
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.216
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.298
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.010
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.337
Epoch: [1]  [ 0/60]  eta: 0:00:20  lr: 0.005000  loss: 0.5511 (0.5511)
loss_classifier: 0.1920 (0.1920)  loss_box_reg: 0.1612 (0.1612)
loss_objectness: 0.1648 (0.1648)  loss_rpn_box_reg: 0.0331 (0.0331)  time:
0.3406  data: 0.0161  max mem: 6148
Epoch: [1]  [10/60]  eta: 0:00:17  lr: 0.005000  loss: 0.5690 (0.5727)
loss_classifier: 0.2151 (0.2002)  loss_box_reg: 0.1867 (0.1851)
loss_objectness: 0.1527 (0.1571)  loss_rpn_box_reg: 0.0286 (0.0303)  time:
0.3459  data: 0.0180  max mem: 6148
Epoch: [1]  [20/60]  eta: 0:00:13  lr: 0.005000  loss: 0.5690 (0.5624)
loss_classifier: 0.1954 (0.1938)  loss_box_reg: 0.1825 (0.1849)
loss_objectness: 0.1500 (0.1522)  loss_rpn_box_reg: 0.0273 (0.0315)  time:
0.3467  data: 0.0202  max mem: 6148
Epoch: [1]  [30/60]  eta: 0:00:16  lr: 0.005000  loss: 0.5306 (0.5500)
loss_classifier: 0.1648 (0.1868)  loss_box_reg: 0.1712 (0.1862)
loss_objectness: 0.1333 (0.1466)  loss_rpn_box_reg: 0.0247 (0.0304)  time:
0.6680  data: 0.0257  max mem: 6148
Epoch: [1]  [40/60]  eta: 0:00:11  lr: 0.005000  loss: 0.4515 (0.5403)
loss_classifier: 0.1470 (0.1817)  loss_box_reg: 0.1768 (0.1862)
loss_objectness: 0.1197 (0.1415)  loss_rpn_box_reg: 0.0234 (0.0310)  time:
0.8131  data: 0.0272  max mem: 6148
Epoch: [1]  [50/60]  eta: 0:00:05  lr: 0.005000  loss: 0.4156 (0.5123)
loss_classifier: 0.1372 (0.1725)  loss_box_reg: 0.1526 (0.1798)
loss_objectness: 0.1015 (0.1317)  loss_rpn_box_reg: 0.0209 (0.0283)  time:
0.4835  data: 0.0226  max mem: 6148
Epoch: [1]  [59/60]  eta: 0:00:00  lr: 0.005000  loss: 0.4156 (0.5094)
loss_classifier: 0.1416 (0.1708)  loss_box_reg: 0.1662 (0.1837)
loss_objectness: 0.0909 (0.1271)  loss_rpn_box_reg: 0.0209 (0.0278)  time:
0.3344  data: 0.0197  max mem: 6148
Epoch: [1] Total time: 0:00:29 (0.4985 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:03  model_time: 0.0557 (0.0557)  evaluator_time:
0.0000 (0.0000)  time: 0.0637  data: 0.0080  max mem: 6148
Test:  [49/50]  eta: 0:00:00  model_time: 0.0244 (0.0283)  evaluator_time:
0.0000 (0.0010)  time: 0.0390  data: 0.0107  max mem: 6148
Test: Total time: 0:00:02 (0.0421 s / it)
Averaged stats: model_time: 0.0244 (0.0283)  evaluator_time: 0.0000 (0.0010)
Accumulating evaluation results…
DONE (t=0.00s).
IoU metric: bbox
```

```
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.195
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.571
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.050
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.002
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.221
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.130
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.365
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.382
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.010
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.431
Epoch: [2]  [ 0/60]  eta: 0:00:22  lr: 0.005000  loss: 0.5799 (0.5799)
loss_classifier: 0.1739 (0.1739)  loss_box_reg: 0.2658 (0.2658)
loss_objectness: 0.1087 (0.1087)  loss_rpn_box_reg: 0.0316 (0.0316)  time:
0.3722  data: 0.0316  max mem: 6148
Epoch: [2]  [10/60]  eta: 0:00:16  lr: 0.005000  loss: 0.4109 (0.4316)
loss_classifier: 0.1268 (0.1341)  loss_box_reg: 0.1743 (0.1775)
loss_objectness: 0.0879 (0.0937)  loss_rpn_box_reg: 0.0182 (0.0263)  time:
0.3363  data: 0.0225  max mem: 6148
Epoch: [2]  [20/60]  eta: 0:00:13  lr: 0.005000  loss: 0.3960 (0.4315)
loss_classifier: 0.1268 (0.1357)  loss_box_reg: 0.1699 (0.1785)
loss_objectness: 0.0867 (0.0934)  loss_rpn_box_reg: 0.0182 (0.0240)  time:
0.3353  data: 0.0229  max mem: 6148
Epoch: [2]  [30/60]  eta: 0:00:10  lr: 0.005000  loss: 0.3972 (0.4112)
loss_classifier: 0.1138 (0.1282)  loss_box_reg: 0.1584 (0.1713)
loss_objectness: 0.0867 (0.0875)  loss_rpn_box_reg: 0.0211 (0.0242)  time:
0.3425  data: 0.0250  max mem: 6148
Epoch: [2]  [40/60]  eta: 0:00:06  lr: 0.005000  loss: 0.3972 (0.4086)
loss_classifier: 0.1149 (0.1265)  loss_box_reg: 0.1665 (0.1728)
loss_objectness: 0.0708 (0.0839)  loss_rpn_box_reg: 0.0210 (0.0255)  time:
0.3433  data: 0.0242  max mem: 6148
Epoch: [2]  [50/60]  eta: 0:00:03  lr: 0.005000  loss: 0.3741 (0.3981)
loss_classifier: 0.1149 (0.1230)  loss_box_reg: 0.1500 (0.1691)
loss_objectness: 0.0699 (0.0807)  loss_rpn_box_reg: 0.0210 (0.0253)  time:
0.3452  data: 0.0219  max mem: 6148
Epoch: [2]  [59/60]  eta: 0:00:00  lr: 0.005000  loss: 0.3927 (0.4001)
loss_classifier: 0.1149 (0.1232)  loss_box_reg: 0.1600 (0.1709)
loss_objectness: 0.0674 (0.0799)  loss_rpn_box_reg: 0.0289 (0.0261)  time:
0.3491  data: 0.0235  max mem: 6148
Epoch: [2] Total time: 0:00:20 (0.3432 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:03  model_time: 0.0640 (0.0640)  evaluator_time:
0.0000 (0.0000)  time: 0.0720  data: 0.0080  max mem: 6148
Test:  [49/50]  eta: 0:00:00  model_time: 0.0241 (0.0297)  evaluator_time:
0.0000 (0.0008)  time: 0.0384  data: 0.0125  max mem: 6148
Test: Total time: 0:00:02 (0.0423 s / it)
```

```
Averaged stats: model_time: 0.0241 (0.0297)  evaluator_time: 0.0000 (0.0008)
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.243
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.617
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.108
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.022
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.273
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.148
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.385
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.391
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.020
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.440
Epoch: [3]  [ 0/60]  eta: 0:00:20  lr: 0.000500  loss: 0.3743 (0.3743)
loss_classifier: 0.1149 (0.1149)  loss_box_reg: 0.1469 (0.1469)
loss_objectness: 0.0644 (0.0644)  loss_rpn_box_reg: 0.0481 (0.0481)  time:
0.3352  data: 0.0160  max mem: 6148
Epoch: [3]  [10/60]  eta: 0:00:17  lr: 0.000500  loss: 0.3807 (0.3834)
loss_classifier: 0.1168 (0.1163)  loss_box_reg: 0.1795 (0.1763)
loss_objectness: 0.0644 (0.0672)  loss_rpn_box_reg: 0.0212 (0.0236)  time:
0.3490  data: 0.0253  max mem: 6148
Epoch: [3]  [20/60]  eta: 0:00:13  lr: 0.000500  loss: 0.3805 (0.3597)
loss_classifier: 0.1098 (0.1123)  loss_box_reg: 0.1795 (0.1658)
loss_objectness: 0.0568 (0.0606)  loss_rpn_box_reg: 0.0206 (0.0209)  time:
0.3472  data: 0.0248  max mem: 6148
Epoch: [3]  [30/60]  eta: 0:00:10  lr: 0.000500  loss: 0.3740 (0.3692)
loss_classifier: 0.1090 (0.1149)  loss_box_reg: 0.1810 (0.1711)
loss_objectness: 0.0571 (0.0617)  loss_rpn_box_reg: 0.0215 (0.0214)  time:
0.3441  data: 0.0235  max mem: 6148
Epoch: [3]  [40/60]  eta: 0:00:06  lr: 0.000500  loss: 0.3541 (0.3581)
loss_classifier: 0.1081 (0.1112)  loss_box_reg: 0.1633 (0.1646)
loss_objectness: 0.0619 (0.0610)  loss_rpn_box_reg: 0.0205 (0.0213)  time:
0.3350  data: 0.0206  max mem: 6148
Epoch: [3]  [50/60]  eta: 0:00:03  lr: 0.000500  loss: 0.3344 (0.3568)
loss_classifier: 0.1019 (0.1115)  loss_box_reg: 0.1580 (0.1632)
loss_objectness: 0.0576 (0.0604)  loss_rpn_box_reg: 0.0192 (0.0217)  time:
0.3381  data: 0.0220  max mem: 6148
Epoch: [3]  [59/60]  eta: 0:00:00  lr: 0.000500  loss: 0.3335 (0.3522)
loss_classifier: 0.1029 (0.1101)  loss_box_reg: 0.1568 (0.1614)
loss_objectness: 0.0557 (0.0595)  loss_rpn_box_reg: 0.0176 (0.0212)  time:
0.3512  data: 0.0269  max mem: 6148
Epoch: [3] Total time: 0:00:20 (0.3445 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:08  model_time: 0.1496 (0.1496)  evaluator_time:
```

```
0.0055 (0.0055)  time: 0.1651  data: 0.0100  max mem: 6148
Test:  [49/50]  eta: 0:00:00  model_time: 0.0313 (0.0388)  evaluator_time:
0.0000 (0.0016)  time: 0.0385  data: 0.0102  max mem: 6148
Test: Total time: 0:00:02 (0.0522 s / it)
Averaged stats: model_time: 0.0313 (0.0388)  evaluator_time: 0.0000 (0.0016)
Accumulating evaluation results…
DONE (t=0.02s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.219
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.592
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.056
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.009
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.253
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.155
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.406
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.418
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.040
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.470
Epoch: [4]  [ 0/60]  eta: 0:00:18  lr: 0.000500  loss: 0.2474 (0.2474)
loss_classifier: 0.0888 (0.0888)  loss_box_reg: 0.1109 (0.1109)
loss_objectness: 0.0376 (0.0376)  loss_rpn_box_reg: 0.0101 (0.0101)  time:
0.3136  data: 0.0304  max mem: 6148
Epoch: [4]  [10/60]  eta: 0:00:16  lr: 0.000500  loss: 0.2681 (0.2908)
loss_classifier: 0.0888 (0.0898)  loss_box_reg: 0.1200 (0.1305)
loss_objectness: 0.0450 (0.0520)  loss_rpn_box_reg: 0.0166 (0.0184)  time:
0.3312  data: 0.0214  max mem: 6148
Epoch: [4]  [20/60]  eta: 0:00:13  lr: 0.000500  loss: 0.3534 (0.3440)
loss_classifier: 0.1051 (0.1059)  loss_box_reg: 0.1506 (0.1565)
loss_objectness: 0.0552 (0.0586)  loss_rpn_box_reg: 0.0178 (0.0230)  time:
0.3396  data: 0.0226  max mem: 6148
Epoch: [4]  [30/60]  eta: 0:00:10  lr: 0.000500  loss: 0.3770 (0.3541)
loss_classifier: 0.1251 (0.1100)  loss_box_reg: 0.1857 (0.1623)
loss_objectness: 0.0602 (0.0597)  loss_rpn_box_reg: 0.0224 (0.0222)  time:
0.3463  data: 0.0230  max mem: 6148
Epoch: [4]  [40/60]  eta: 0:00:06  lr: 0.000500  loss: 0.3395 (0.3547)
loss_classifier: 0.1052 (0.1104)  loss_box_reg: 0.1665 (0.1619)
loss_objectness: 0.0565 (0.0608)  loss_rpn_box_reg: 0.0197 (0.0216)  time:
0.3491  data: 0.0216  max mem: 6148
Epoch: [4]  [50/60]  eta: 0:00:03  lr: 0.000500  loss: 0.2928 (0.3515)
loss_classifier: 0.0990 (0.1091)  loss_box_reg: 0.1315 (0.1615)
loss_objectness: 0.0514 (0.0594)  loss_rpn_box_reg: 0.0192 (0.0214)  time:
0.3468  data: 0.0220  max mem: 6148
Epoch: [4]  [59/60]  eta: 0:00:00  lr: 0.000500  loss: 0.2719 (0.3432)
loss_classifier: 0.0862 (0.1069)  loss_box_reg: 0.1240 (0.1577)
loss_objectness: 0.0528 (0.0581)  loss_rpn_box_reg: 0.0171 (0.0205)  time:
0.3389  data: 0.0215  max mem: 6148
```

```
Epoch: [4] Total time: 0:00:20 (0.3417 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:04  model_time: 0.0785 (0.0785)  evaluator_time:
0.0000 (0.0000)  time: 0.0873  data: 0.0088  max mem: 6148
Test:  [49/50]  eta: 0:00:00  model_time: 0.0312 (0.0319)  evaluator_time:
0.0000 (0.0022)  time: 0.0400  data: 0.0101  max mem: 6148
Test: Total time: 0:00:02 (0.0440 s / it)
Averaged stats: model_time: 0.0312 (0.0319)  evaluator_time: 0.0000 (0.0022)
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.244
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.621
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.111
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.036
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.274
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.152
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.413
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.431
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.060
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.482
Epoch: [5]  [ 0/60]  eta: 0:00:19  lr: 0.000500  loss: 0.2495 (0.2495)
loss_classifier: 0.0823 (0.0823)  loss_box_reg: 0.1140 (0.1140)
loss_objectness: 0.0396 (0.0396)  loss_rpn_box_reg: 0.0137 (0.0137)  time:
0.3186  data: 0.0160  max mem: 6148
Epoch: [5]  [10/60]  eta: 0:00:17  lr: 0.000500  loss: 0.3370 (0.3366)
loss_classifier: 0.1025 (0.1050)  loss_box_reg: 0.1613 (0.1612)
loss_objectness: 0.0431 (0.0531)  loss_rpn_box_reg: 0.0166 (0.0173)  time:
0.3508  data: 0.0309  max mem: 6148
Epoch: [5]  [20/60]  eta: 0:00:20  lr: 0.000500  loss: 0.3102 (0.3209)
loss_classifier: 0.0978 (0.0992)  loss_box_reg: 0.1477 (0.1519)
loss_objectness: 0.0492 (0.0526)  loss_rpn_box_reg: 0.0160 (0.0172)  time:
0.5303  data: 0.0270  max mem: 6148
Epoch: [5]  [30/60]  eta: 0:00:17  lr: 0.000500  loss: 0.2994 (0.3141)
loss_classifier: 0.0928 (0.0966)  loss_box_reg: 0.1425 (0.1466)
loss_objectness: 0.0497 (0.0538)  loss_rpn_box_reg: 0.0155 (0.0172)  time:
0.7086  data: 0.0210  max mem: 6148
Epoch: [5]  [40/60]  eta: 0:00:10  lr: 0.000500  loss: 0.2994 (0.3319)
loss_classifier: 0.0993 (0.1026)  loss_box_reg: 0.1410 (0.1560)
loss_objectness: 0.0538 (0.0558)  loss_rpn_box_reg: 0.0180 (0.0176)  time:
0.5276  data: 0.0212  max mem: 6148
Epoch: [5]  [50/60]  eta: 0:00:04  lr: 0.000500  loss: 0.3260 (0.3307)
loss_classifier: 0.0999 (0.1018)  loss_box_reg: 0.1403 (0.1548)
loss_objectness: 0.0585 (0.0561)  loss_rpn_box_reg: 0.0208 (0.0181)  time:
0.3451  data: 0.0232  max mem: 6148
```

```
Epoch: [5]  [59/60]  eta: 0:00:00  lr: 0.000500  loss: 0.3140 (0.3367)
loss_classifier: 0.0979 (0.1037)  loss_box_reg: 0.1370 (0.1572)
loss_objectness: 0.0580 (0.0567)  loss_rpn_box_reg: 0.0193 (0.0192)  time:
0.3411  data: 0.0219  max mem: 6148
Epoch: [5] Total time: 0:00:27 (0.4663 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:04  model_time: 0.0751 (0.0751)  evaluator_time:
0.0066 (0.0066)  time: 0.0900  data: 0.0083  max mem: 6148
Test:  [49/50]  eta: 0:00:00  model_time: 0.0312 (0.0311)  evaluator_time:
0.0000 (0.0022)  time: 0.0418  data: 0.0110  max mem: 6148
Test: Total time: 0:00:02 (0.0454 s / it)
Averaged stats: model_time: 0.0312 (0.0311)  evaluator_time: 0.0000 (0.0022)
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.237
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.660
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.077
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.015
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.267
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.152
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.414
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.417
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.060
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.466
Epoch: [6]  [ 0/60]  eta: 0:00:18  lr: 0.000050  loss: 0.4361 (0.4361)
loss_classifier: 0.1159 (0.1159)  loss_box_reg: 0.2174 (0.2174)
loss_objectness: 0.0768 (0.0768)  loss_rpn_box_reg: 0.0260 (0.0260)  time:
0.3145  data: 0.0233  max mem: 6148
Epoch: [6]  [10/60]  eta: 0:00:16  lr: 0.000050  loss: 0.3672 (0.3585)
loss_classifier: 0.1066 (0.1096)  loss_box_reg: 0.1854 (0.1710)
loss_objectness: 0.0433 (0.0574)  loss_rpn_box_reg: 0.0195 (0.0205)  time:
0.3391  data: 0.0189  max mem: 6148
Epoch: [6]  [20/60]  eta: 0:00:13  lr: 0.000050  loss: 0.3282 (0.3419)
loss_classifier: 0.0984 (0.1019)  loss_box_reg: 0.1633 (0.1645)
loss_objectness: 0.0445 (0.0543)  loss_rpn_box_reg: 0.0203 (0.0212)  time:
0.3427  data: 0.0212  max mem: 6148
Epoch: [6]  [30/60]  eta: 0:00:10  lr: 0.000050  loss: 0.3231 (0.3407)
loss_classifier: 0.0918 (0.1029)  loss_box_reg: 0.1579 (0.1645)
loss_objectness: 0.0509 (0.0528)  loss_rpn_box_reg: 0.0203 (0.0205)  time:
0.3408  data: 0.0219  max mem: 6148
Epoch: [6]  [40/60]  eta: 0:00:06  lr: 0.000050  loss: 0.2686 (0.3317)
loss_classifier: 0.0856 (0.1009)  loss_box_reg: 0.1393 (0.1578)
loss_objectness: 0.0528 (0.0537)  loss_rpn_box_reg: 0.0143 (0.0193)  time:
0.3409  data: 0.0210  max mem: 6148
```

```
Epoch: [6]  [50/60]  eta: 0:00:03  lr: 0.000050  loss: 0.3137 (0.3370)
loss_classifier: 0.1047 (0.1029)  loss_box_reg: 0.1501 (0.1584)
loss_objectness: 0.0533 (0.0552)  loss_rpn_box_reg: 0.0167 (0.0204)  time:
0.4862  data: 0.0259  max mem: 6148
Epoch: [6]  [59/60]  eta: 0:00:00  lr: 0.000050  loss: 0.2915 (0.3298)
loss_classifier: 0.0996 (0.1014)  loss_box_reg: 0.1382 (0.1554)
loss_objectness: 0.0485 (0.0533)  loss_rpn_box_reg: 0.0159 (0.0197)  time:
0.6542  data: 0.0280  max mem: 6148
Epoch: [6] Total time: 0:00:26 (0.4458 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:04  model_time: 0.0713 (0.0713)  evaluator_time:
0.0000 (0.0000)  time: 0.0837  data: 0.0125  max mem: 6148
Test:  [49/50]  eta: 0:00:00  model_time: 0.0280 (0.0319)  evaluator_time:
0.0000 (0.0013)  time: 0.0435  data: 0.0140  max mem: 6148
Test: Total time: 0:00:02 (0.0474 s / it)
Averaged stats: model_time: 0.0280 (0.0319)  evaluator_time: 0.0000 (0.0013)
Accumulating evaluation results…
DONE (t=0.01s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.248
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.638
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.056
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.016
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.281
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.163
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.417
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.430
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.050
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.482
Epoch: [7]  [ 0/60]  eta: 0:00:21  lr: 0.000050  loss: 0.4142 (0.4142)
loss_classifier: 0.1195 (0.1195)  loss_box_reg: 0.2249 (0.2249)
loss_objectness: 0.0505 (0.0505)  loss_rpn_box_reg: 0.0193 (0.0193)  time:
0.3618  data: 0.0285  max mem: 6148
Epoch: [7]  [10/60]  eta: 0:00:17  lr: 0.000050  loss: 0.3339 (0.3313)
loss_classifier: 0.0971 (0.1028)  loss_box_reg: 0.1538 (0.1624)
loss_objectness: 0.0476 (0.0494)  loss_rpn_box_reg: 0.0193 (0.0167)  time:
0.3465  data: 0.0253  max mem: 6233
Epoch: [7]  [20/60]  eta: 0:00:13  lr: 0.000050  loss: 0.2858 (0.3141)
loss_classifier: 0.0877 (0.0978)  loss_box_reg: 0.1453 (0.1508)
loss_objectness: 0.0431 (0.0491)  loss_rpn_box_reg: 0.0159 (0.0165)  time:
0.3454  data: 0.0252  max mem: 6233
Epoch: [7]  [30/60]  eta: 0:00:10  lr: 0.000050  loss: 0.3075 (0.3301)
loss_classifier: 0.0947 (0.1013)  loss_box_reg: 0.1507 (0.1562)
loss_objectness: 0.0574 (0.0547)  loss_rpn_box_reg: 0.0177 (0.0179)  time:
0.3450  data: 0.0266  max mem: 6233
```

```
Epoch: [7]  [40/60]  eta: 0:00:06  lr: 0.000050  loss: 0.3770 (0.3285)
loss_classifier: 0.1118 (0.1024)  loss_box_reg: 0.1673 (0.1545)
loss_objectness: 0.0574 (0.0535)  loss_rpn_box_reg: 0.0170 (0.0181)  time:
0.3488  data: 0.0258  max mem: 6320
Epoch: [7]  [50/60]  eta: 0:00:03  lr: 0.000050  loss: 0.3595 (0.3307)
loss_classifier: 0.1084 (0.1018)  loss_box_reg: 0.1673 (0.1559)
loss_objectness: 0.0478 (0.0537)  loss_rpn_box_reg: 0.0179 (0.0193)  time:
0.3502  data: 0.0241  max mem: 6320
Epoch: [7]  [59/60]  eta: 0:00:00  lr: 0.000050  loss: 0.3358 (0.3341)
loss_classifier: 0.0981 (0.1038)  loss_box_reg: 0.1378 (0.1566)
loss_objectness: 0.0516 (0.0543)  loss_rpn_box_reg: 0.0179 (0.0194)  time:
0.3423  data: 0.0202  max mem: 6320
Epoch: [7] Total time: 0:00:20 (0.3460 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:05  model_time: 0.0792 (0.0792)  evaluator_time:
0.0065 (0.0065)  time: 0.1002  data: 0.0145  max mem: 6320
Test:  [49/50]  eta: 0:00:00  model_time: 0.0288 (0.0320)  evaluator_time:
0.0000 (0.0012)  time: 0.0400  data: 0.0111  max mem: 6320
Test: Total time: 0:00:02 (0.0445 s / it)
Averaged stats: model_time: 0.0288 (0.0320)  evaluator_time: 0.0000 (0.0012)
Accumulating evaluation results…
DONE (t=0.00s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.245
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.655
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.076
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.019
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.279
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.146
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.426
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.433
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.050
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.485
Epoch: [8]  [ 0/60]  eta: 0:00:20  lr: 0.000050  loss: 0.4599 (0.4599)
loss_classifier: 0.1401 (0.1401)  loss_box_reg: 0.2183 (0.2183)
loss_objectness: 0.0747 (0.0747)  loss_rpn_box_reg: 0.0267 (0.0267)  time:
0.3500  data: 0.0328  max mem: 6320
Epoch: [8]  [10/60]  eta: 0:00:17  lr: 0.000050  loss: 0.3056 (0.3265)
loss_classifier: 0.0968 (0.0973)  loss_box_reg: 0.1573 (0.1545)
loss_objectness: 0.0548 (0.0539)  loss_rpn_box_reg: 0.0192 (0.0208)  time:
0.3563  data: 0.0267  max mem: 6320
Epoch: [8]  [20/60]  eta: 0:00:25  lr: 0.000050  loss: 0.3056 (0.3371)
loss_classifier: 0.0986 (0.1053)  loss_box_reg: 0.1428 (0.1555)
loss_objectness: 0.0548 (0.0561)  loss_rpn_box_reg: 0.0170 (0.0202)  time:
0.6407  data: 0.0251  max mem: 6320
```

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Epoch: [8]  [30/60]  eta: 0:00:19  lr: 0.000050  loss: 0.3302 (0.3446)
loss_classifier: 0.1027 (0.1066)  loss_box_reg: 0.1749 (0.1648)
loss_objectness: 0.0418 (0.0529)  loss_rpn_box_reg: 0.0186 (0.0202)  time:
0.8012  data: 0.0245  max mem: 6320
Epoch: [8]  [40/60]  eta: 0:00:12  lr: 0.000050  loss: 0.3323 (0.3446)
loss_classifier: 0.1033 (0.1070)  loss_box_reg: 0.1749 (0.1645)
loss_objectness: 0.0418 (0.0529)  loss_rpn_box_reg: 0.0191 (0.0203)  time:
0.6187  data: 0.0267  max mem: 6320
Epoch: [8]  [50/60]  eta: 0:00:05  lr: 0.000050  loss: 0.3199 (0.3387)
loss_classifier: 0.0931 (0.1046)  loss_box_reg: 0.1516 (0.1613)
loss_objectness: 0.0495 (0.0526)  loss_rpn_box_reg: 0.0186 (0.0202)  time:
0.4446  data: 0.0235  max mem: 6320
Epoch: [8]  [59/60]  eta: 0:00:00  lr: 0.000050  loss: 0.2659 (0.3297)
loss_classifier: 0.0904 (0.1019)  loss_box_reg: 0.1244 (0.1562)
loss_objectness: 0.0450 (0.0518)  loss_rpn_box_reg: 0.0166 (0.0198)  time:
0.3368  data: 0.0212  max mem: 6320
Epoch: [8] Total time: 0:00:31 (0.5318 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:03  model_time: 0.0793 (0.0793)  evaluator_time:
0.0000 (0.0000)  time: 0.0793  data: 0.0000  max mem: 6320
Test:  [49/50]  eta: 0:00:00  model_time: 0.0262 (0.0294)  evaluator_time:
0.0000 (0.0027)  time: 0.0402  data: 0.0113  max mem: 6320
Test: Total time: 0:00:02 (0.0439 s / it)
Averaged stats: model_time: 0.0262 (0.0294)  evaluator_time: 0.0000 (0.0027)
Accumulating evaluation results…
DONE (t=0.02s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.224
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.622
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.083
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.015
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.254
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.152
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.399
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.413
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.030
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.464
Epoch: [9]  [ 0/60]  eta: 0:00:22  lr: 0.000005  loss: 0.2802 (0.2802)
loss_classifier: 0.0843 (0.0843)  loss_box_reg: 0.1019 (0.1019)
loss_objectness: 0.0645 (0.0645)  loss_rpn_box_reg: 0.0295 (0.0295)  time:
0.3692  data: 0.0310  max mem: 6320
Epoch: [9]  [10/60]  eta: 0:00:17  lr: 0.000005  loss: 0.3079 (0.3421)
loss_classifier: 0.0964 (0.1069)  loss_box_reg: 0.1603 (0.1664)
loss_objectness: 0.0446 (0.0504)  loss_rpn_box_reg: 0.0178 (0.0184)  time:
0.3411  data: 0.0234  max mem: 6320
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Epoch: [9]  [20/60]  eta: 0:00:13  lr: 0.000005  loss: 0.3587 (0.3428)
loss_classifier: 0.1064 (0.1067)  loss_box_reg: 0.1723 (0.1678)
loss_objectness: 0.0452 (0.0502)  loss_rpn_box_reg: 0.0170 (0.0181)  time:
0.3449  data: 0.0239  max mem: 6320
Epoch: [9]  [30/60]  eta: 0:00:10  lr: 0.000005  loss: 0.3655 (0.3349)
loss_classifier: 0.1062 (0.1043)  loss_box_reg: 0.1528 (0.1613)
loss_objectness: 0.0489 (0.0518)  loss_rpn_box_reg: 0.0170 (0.0176)  time:
0.3521  data: 0.0248  max mem: 6320
Epoch: [9]  [40/60]  eta: 0:00:07  lr: 0.000005  loss: 0.2644 (0.3230)
loss_classifier: 0.0814 (0.1001)  loss_box_reg: 0.1194 (0.1540)
loss_objectness: 0.0423 (0.0515)  loss_rpn_box_reg: 0.0146 (0.0174)  time:
0.3641  data: 0.0229  max mem: 6320
Epoch: [9]  [50/60]  eta: 0:00:05  lr: 0.000005  loss: 0.2754 (0.3272)
loss_classifier: 0.0903 (0.1018)  loss_box_reg: 0.1194 (0.1536)
loss_objectness: 0.0483 (0.0530)  loss_rpn_box_reg: 0.0153 (0.0187)  time:
0.7517  data: 0.0209  max mem: 6320
Epoch: [9]  [59/60]  eta: 0:00:00  lr: 0.000005  loss: 0.2881 (0.3297)
loss_classifier: 0.0971 (0.1024)  loss_box_reg: 0.1381 (0.1560)
loss_objectness: 0.0522 (0.0523)  loss_rpn_box_reg: 0.0198 (0.0191)  time:
1.0508  data: 0.0215  max mem: 6320
Epoch: [9] Total time: 0:00:34 (0.5805 s / it)
creating index…
index created!
Test:  [ 0/50]  eta: 0:00:07  model_time: 0.1399 (0.1399)  evaluator_time:
0.0000 (0.0000)  time: 0.1479  data: 0.0080  max mem: 6320
Test:  [49/50]  eta: 0:00:00  model_time: 0.0252 (0.0432)  evaluator_time:
0.0000 (0.0009)  time: 0.0400  data: 0.0099  max mem: 6320
Test: Total time: 0:00:02 (0.0564 s / it)
Averaged stats: model_time: 0.0252 (0.0432)  evaluator_time: 0.0000 (0.0009)
Accumulating evaluation results…
DONE (t=0.02s).
IoU metric: bbox
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.257
 Average Precision  (AP) @[ IoU=0.50      | area=   all | maxDets=100 ] = 0.664
 Average Precision  (AP) @[ IoU=0.75      | area=   all | maxDets=100 ] = 0.112
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Precision  (AP) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.011
 Average Precision  (AP) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.292
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=  1 ] = 0.168
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets= 10 ] = 0.432
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=   all | maxDets=100 ] = 0.442
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= small | maxDets=100 ] = 0.000
 Average Recall     (AR) @[ IoU=0.50:0.95 | area=medium | maxDets=100 ] = 0.040
 Average Recall     (AR) @[ IoU=0.50:0.95 | area= large | maxDets=100 ] = 0.496
That's it!
```

The two models have been evaluated using the Intersection over Union (IoU) metric for both bounding boxes (bbox) and segmentation masks (segm).

The IoU metric measures the overlap between the predicted and ground truth bounding boxes/masks. An IoU score of 1 indicates perfect overlap, while a score of 0 indicates no overlap at all.

Model 1 has higher average precision (AP) and average recall (AR) values than Model 2 for both bbox and segm metrics. This indicates that Model 1 has better performance overall in detecting and localizing objects in the images.

For bbox metric, Model 1 has AP values ranging from 0.799 to 0.349 across different areas and IoU thresholds. For the same metric, Model 2 has AP values ranging from 0.707 to 0.004. Model 1 has a higher AP score than Model 2 for all AP values, indicating that it performs better at detecting and localizing objects.

For segm metric, Model 1 has AP values ranging from 0.761 to 0.341, while Model 2 has AP values ranging from 0.296 to -1.000. Here, too, Model 1 has higher AP scores than Model 2 for all AP values.

In summary, based on the evaluation metrics, Model 1 performs better than Model 2 in object detection and localization for the given dataset.

[7]:
```
import torch
import torchvision
from PIL import Image
import matplotlib.pyplot as plt
url = "https://upload.wikimedia.org/wikipedia/en/4/42/Beatles_-_Abbey_Road.jpg"
img = Image.open(requests.get(url, stream=True).raw)



transform = transforms.Compose([transforms.Resize(256),
                                          transforms.CenterCrop(224),
                                    transforms.ToTensor(),
                                          ])
img = transform(img).to(device)



# Plot the original image
plt.imshow(transforms.ToPILImage()(img))
print ("Original Image")
plt.show()

transform = torchvision.transforms.Compose([
    torchvision.transforms.Resize(256),
    torchvision.transforms.CenterCrop(224),

    torchvision.transforms.Normalize(
        mean=[0.485, 0.456, 0.406],
        std=[0.229, 0.224, 0.225]
```

```
    )
])
img = transform(img).to(device)


print("OPTION 1")
# Make a prediction
with torch.no_grad():
    output = model_option1(img.unsqueeze(0))
    print('Prediction for model_option1: \n', pred_option1)



# Filter the output to keep only the top scoring boxes
threshold = 0.5
_boxes = output[0]['boxes']

# Draw the boxes on the image
fig, ax = plt.subplots()
ax.imshow(transforms.ToPILImage()(img))
for box in _boxes:
    x1, y1, x2, y2 = box.tolist()
    w, h = x2 - x1, y2 - y1
    rect = plt.Rectangle((x1, y1), w, h, linewidth=1,edgecolor='r',␣
 ↪facecolor='none')
    ax.add_patch(rect)
plt.show()



print("OPTION 2")
# Make a prediction
with torch.no_grad():
    output = model_option2(img.unsqueeze(0))
    print('Prediction for model_option2: \n', pred_option2)

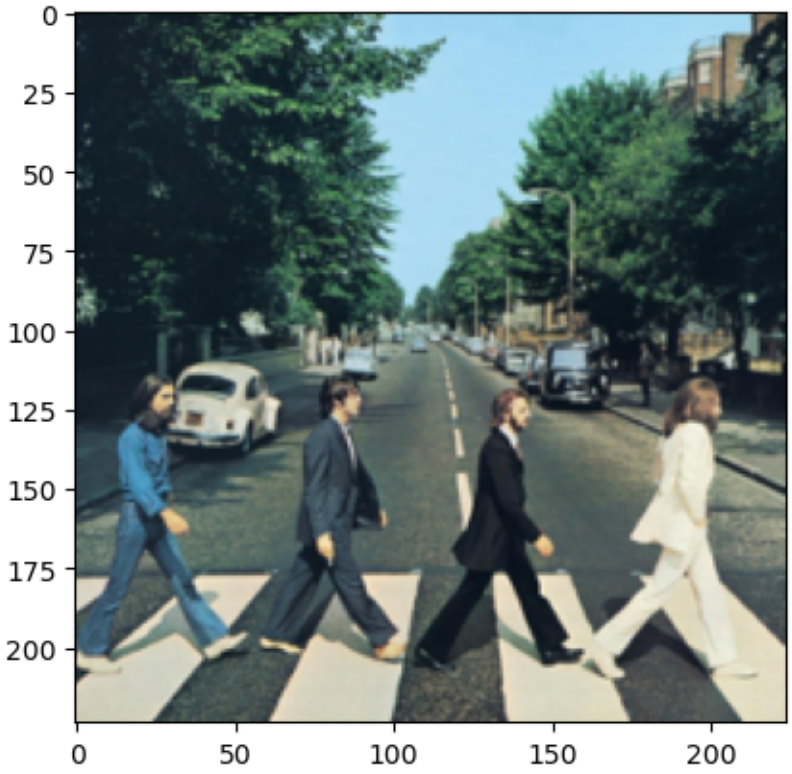


# Filter the output to keep only the top scoring boxes
threshold = 0.5
_boxes = output[0]['boxes']

# Draw the boxes on the image
fig, ax = plt.subplots()
ax.imshow(transforms.ToPILImage()(img))
for box in _boxes:
    x1, y1, x2, y2 = box.tolist()
```

```
    w, h = x2 - x1, y2 - y1
    rect = plt.Rectangle((x1, y1), w, h, linewidth=1,edgecolor='r',␣
 ↪facecolor='none')
    ax.add_patch(rect)
plt.show()
```

Original Image



OPTION 1

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[7], line 39
     37 with torch.no_grad():
     38     output = model_option1(img.unsqueeze(0))
---> 39     print('Prediction for model_option1: \n', pred_option1)
     43 # Filter the output to keep only the top scoring boxes
     44 threshold = 0.5

NameError: name 'pred_option1' is not defined
```

[ ]:

[ ]: