ModelExamples

February 15, 2020

In [1]:
```
import os
import sys
import imp
import json
import onnx
import torch
import urllib
import onnxruntime
import numpy as np
import torchvision.models
import matplotlib.pyplot as plt

from PIL import Image
from torchvision import transforms
```

In [2]:
```
CUDA=False
EXPORT=False
def preprocess_image_to_batch(input_image):
    preprocess = transforms.Compose([
    transforms.Resize(256),
    transforms.CenterCrop(224),
    transforms.ToTensor(),
    transforms.Normalize(mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225]),
        ])
    input_tensor = preprocess(input_image)
    input_batch = input_tensor.unsqueeze(0)
    return input_batch
def run_through_model(input_image,model):
    #preprocessing image
    input_batch = preprocess_image_to_batch(input_image)
    if torch.cuda.is_available() and CUDA:
        input_batch = input_batch.to('cuda')
        model.to('cuda')

    with torch.no_grad():
        output = model(input_batch)
    # Tensor of shape 1000, with confidence scores over Imagenet's 1000 classes
```

```
        result = (output[0])
        # running softmax to get probabilities
        result = torch.nn.functional.softmax(result, dim=0)
        return result
```

In [3]:
```
# source https://pytorch.org/tutorials/advanced/super_resolution_with_onnxruntime.html
def export_model_to_onnx(model,sample_input,export_path):
    torch.onnx.export(
                    model,
                    sample_input,
                    export_path,
                    export_params=True,
                    opset_version=10,          # the ONNX version to export the model to
                    do_constant_folding=True,  # whether to execute constant folding for
                    input_names = ['input'],   # the model's input names
                    output_names = ['output'], # the model's output names
                    dynamic_axes={'input' : {0 : 'batch_size'},    # variable lenght axe
                                  'output' : {0 : 'batch_size'}}
                       )
def to_numpy(tensor):
    return tensor.detach().cpu().numpy() if tensor.requires_grad else tensor.cpu().num

def verify_onnx_export(torch_model,sample_input,export_path):
    #verification
    onnx_model = onnx.load(export_path)
    onnx.checker.check_model(onnx_model)

    # check if outputs are close
    torch_out = torch_model(sample_input)
    ort_session = onnxruntime.InferenceSession(export_path)

    # compute ONNX Runtime output prediction
    ort_inputs = {ort_session.get_inputs()[0].name: to_numpy(sample_input)}
    ort_outs = ort_session.run(None, ort_inputs)

    # compare ONNX Runtime and PyTorch results
    np.testing.assert_allclose(to_numpy(torch_out), ort_outs[0], rtol=1e-03, atol=1e-05

    print("Verified")
```

0.1 Resnet50 V1.50

In [4]:
```
imagenet_map = json.load(open("imagenet_class_index.json"))
model = torchvision.models.resnet34(pretrained=True, progress=True)
model.eval() #putting model in eval mode

filename = './car.jpeg'
input_image = Image.open(filename)
```

```
result = run_through_model(input_image,model)

prediction = torch.argmax(result).item()
predicted_label = imagenet_map[str(prediction)][1]
```

0.2 Inference using Torch

```
In [5]: print("Input Image")
        print(plt.imshow(input_image))
        print("Prediction : ",predicted_label)
```

```
Input Image
AxesImage(54,36;334.8x217.44)
Prediction :  sports_car
```


```
In [6]: sample_input = preprocess_image_to_batch(input_image)
        export_path = "./exported_models/resnetv1.5_224.onnx"

        #exporting model to onnx
        if EXPORT:
            export_model_to_onnx(model = model,
                                 sample_input = sample_input,
                                 export_path = export_path)
        #verifying
        verify_onnx_export(torch_model = model,
```

```
                                sample_input = sample_input,
                                export_path = export_path)
```

```
Verified
```

0.3 Inference using ONNX

```
In [7]: # inference using onnx model
        onnx_model = onnx.load(export_path)
        onnx.checker.check_model(onnx_model)


        ort_session = onnxruntime.InferenceSession(export_path)

        # compute ONNX Runtime output prediction
        ort_inputs = {ort_session.get_inputs()[0].name: to_numpy(sample_input)}
        ort_outs = ort_session.run(None, ort_inputs)

        prediction = np.argmax(ort_outs[0]).item()
        predicted_label = imagenet_map[str(prediction)][1]

        print("Input Image")
        print(plt.imshow(input_image))
        print("Prediction : ",predicted_label)
```

```
Input Image
AxesImage(54,36;334.8x217.44)
Prediction :  sports_car
```

0.4 MobileNet V1 224

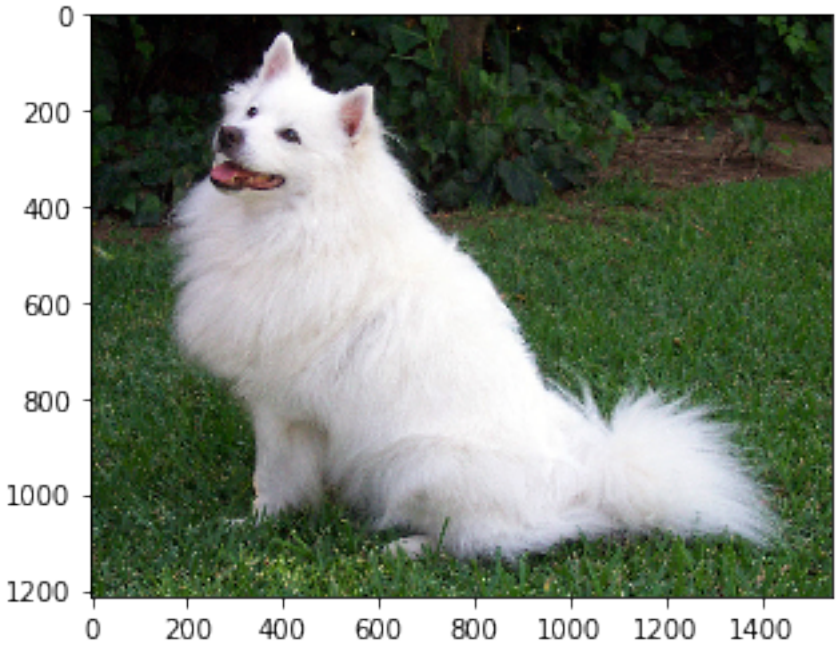
```
In [8]: ckpt_path = "./pretrained_models/mobilenetv1/pytorch/tf_mobilenetv1_224_to_pytorch.pth"
        # required by mmdnn to load model
        MainModel = imp.load_source('MainModel', "./pretrained_models/mobilenetv1/pytorch/tf_mo
        model = torch.load(ckpt_path)
        model.eval() #putting model in eval mode

        filename = "./dog.jpg"
        input_image = Image.open(filename)
        result = run_through_model(input_image,model)

        prediction = torch.argmax(result).item()
        predicted_label = imagenet_map[str(prediction)][1]
```

```
/home/aghinsa/anaconda3/lib/python3.6/site-packages/torch/serialization.py:593: SourceChangeWar
  warnings.warn(msg, SourceChangeWarning)
./pretrained_models/mobilenetv1/pytorch/tf_mobilenetv1_224_to_pytorch.py:184: UserWarning: Impl
  MobilenetV1_Predictions_Softmax = F.softmax(MobilenetV1_Predictions_Reshape)
```

0.5 Inference using Torch

```
In [9]: print("Input Image")
        print(plt.imshow(input_image))
        print("Prediction : ",predicted_label)
```

```
Input Image
AxesImage(54,36;334.8x217.44)
Prediction :  Pomeranian
```




```
In [10]: sample_input = preprocess_image_to_batch(input_image)
         export_path = "./exported_models/mobilenetv1_224.onnx"
         if EXPORT:
             torch.onnx.export(
                         model,
                         sample_input,
                         export_path,
                         export_params=True,
                         opset_version=7,          # the ONNX version to export the model to
                         do_constant_folding=True,  # whether to execute constant folding fo
                         input_names = ['input'],   # the model's input names
                         output_names = ['output'], # the model's output names
                         dynamic_axes={'input' : {0 : 'batch_size'},    # variable lenght ax
                                       'output' : {0 : 'batch_size'}}
                            )
```

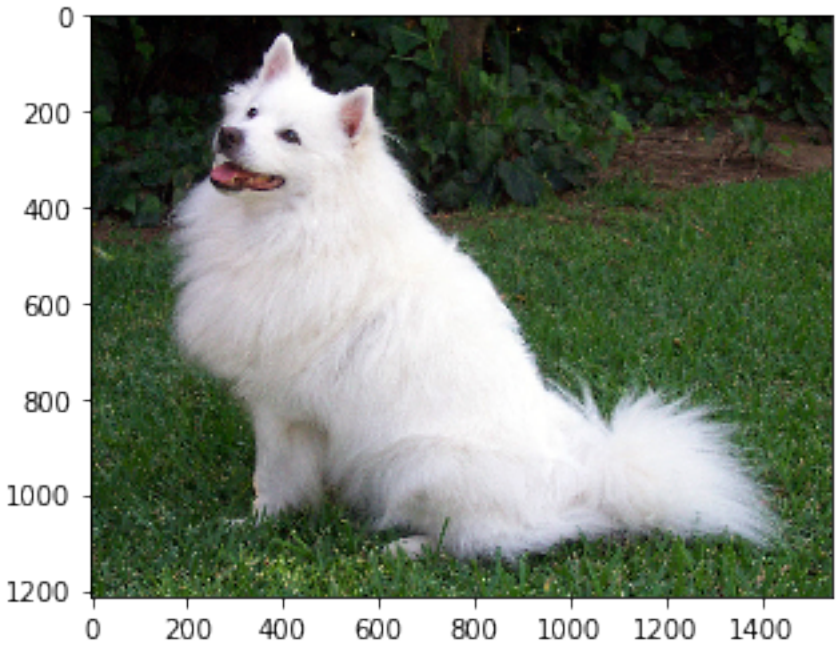
```
In [11]: onnx_model = onnx.load(export_path)
         onnx.checker.check_model(onnx_model)
```

0.6 Inference using ONNX

```
In [12]: #inference using onnx

         ort_session = onnxruntime.InferenceSession(export_path)

         # compute ONNX Runtime output prediction
```

```
        ort_inputs = {ort_session.get_inputs()[0].name: to_numpy(sample_input)}
        ort_outs = ort_session.run(None, ort_inputs)

        prediction = np.argmax(ort_outs[0]).item()
        predicted_label = imagenet_map[str(prediction)][1]

        print("Input Image")
        print(plt.imshow(input_image))
        print("Prediction : ",predicted_label)
```

```
Input Image
AxesImage(54,36;334.8x217.44)
Prediction :  Pomeranian
```



0.7 SSD-ResNet34 COCO (1200x1200)

```
In [13]: %load_ext autoreload
         %autoreload 2
```

```
In [14]: from object_detection_utils import draw_bounding_box_on_image
         models_src_path= "./inference-master/v0.5/classification_and_detection/python/"
         sys.path.insert(0,models_src_path)
         from models.ssd_r34 import SSD_R34,dboxes_R34_coco,Encoder
```

```
In [15]: def preprocess_image_to_batch(input_image,img_size):
             preprocess = transforms.Compose([
```

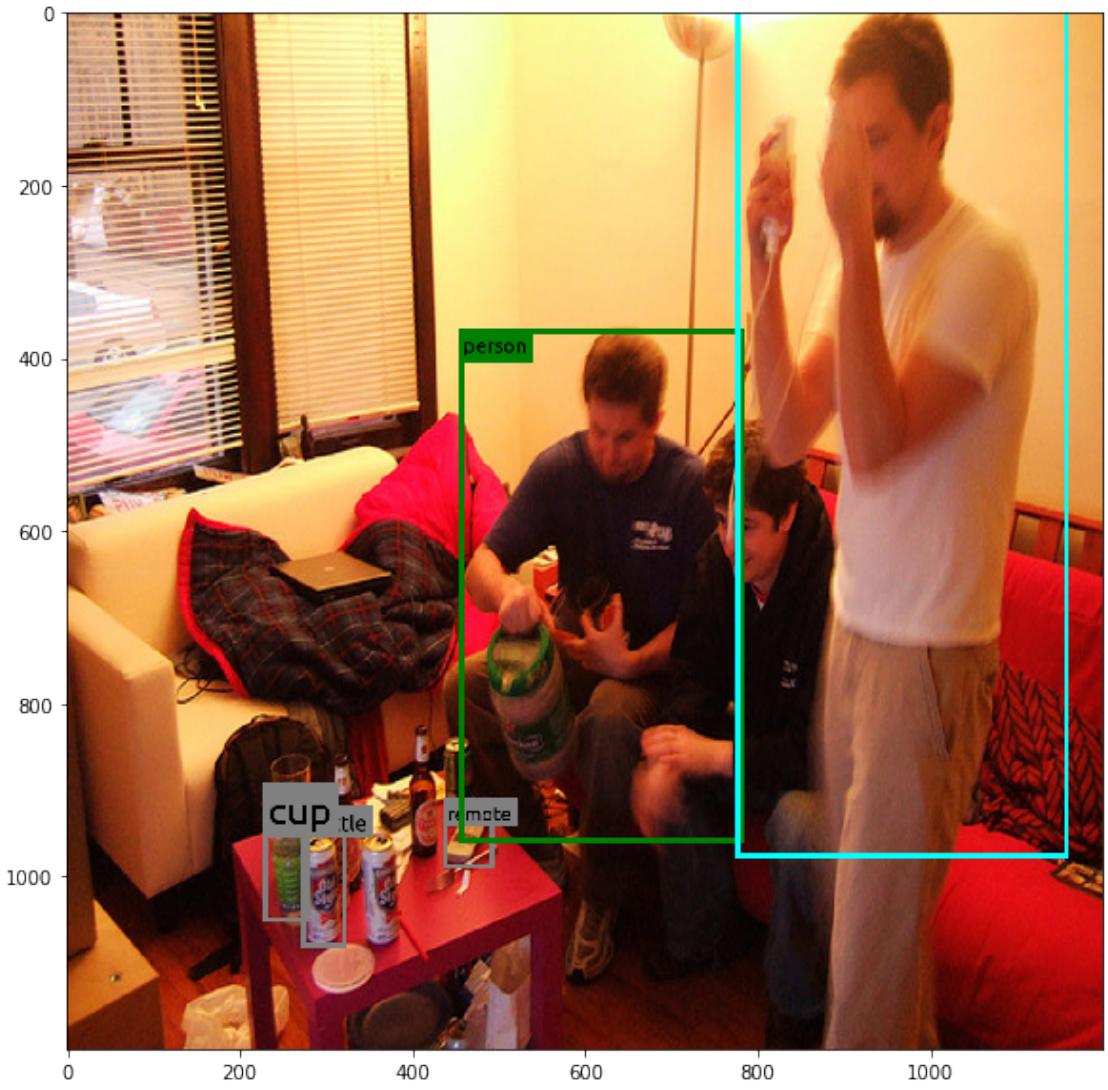
```
            transforms.Resize(img_size),
            transforms.ToTensor(),
            transforms.Normalize(mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225]),
        ])
        input_tensor = preprocess(input_image)
        input_batch = input_tensor.unsqueeze(0)
        return input_batch
```

In [16]:
```
ckpt_path = "./pretrained_models/resnet34-ssd1200.pth"
model_state,label_dict = torch.load(ckpt_path).values()

model = SSD_R34(extract_shapes=True)
model.load_state_dict(model_state)
model.eval()


filename = "000000010707.jpg"
input_image = Image.open(filename)

img_size= [1200,1200]
input_image = input_image.resize(img_size)
input_batch = preprocess_image_to_batch(input_image,img_size)

if torch.cuda.is_available() and CUDA :
    input_batch = input_batch.to('cuda')
    model.to('cuda')

with torch.no_grad():
    locs,confs,feature_shapes= model(input_batch)

dboxes = dboxes_R34_coco(img_size, [3, 3, 2, 2, 2, 2])
encoder = Encoder(dboxes)
#low criteria -> high confidence
boxes, labels, scores = encoder.decode_batch(locs,confs,criteria=0.05, max_output=5)
boxes = boxes[0]
labels = labels[0]
```

0.8 Inference using Torch

In [17]:
```
for box,label in zip(boxes,labels):
    box = box.cpu().detach().numpy()
    label = label_dict[label.item()]
    draw_bounding_box_on_image(input_image, box, label)

fig = plt.gcf()
fig.set_size_inches(10, 10)
plt.imshow(input_image)
```

Out[17]:
```
<matplotlib.image.AxesImage at 0x7efdbc6c9ac8>
```



In [18]:
```
sample_input = preprocess_image_to_batch(input_image,img_size)
export_path = "./exported_models/ssd_resnet34_1200.onnx"

#exporting model to onnx
if EXPORT :
    torch.onnx.export(
                    model,
                    sample_input,
                    export_path,
                    export_params=True,
                    opset_version=7,          # the ONNX version to export the model to
                    do_constant_folding=True,  # whether to execute constant folding fo
                    input_names = ['input'],   # the model's input names
                    output_names = ['output'], # the model's output names
```

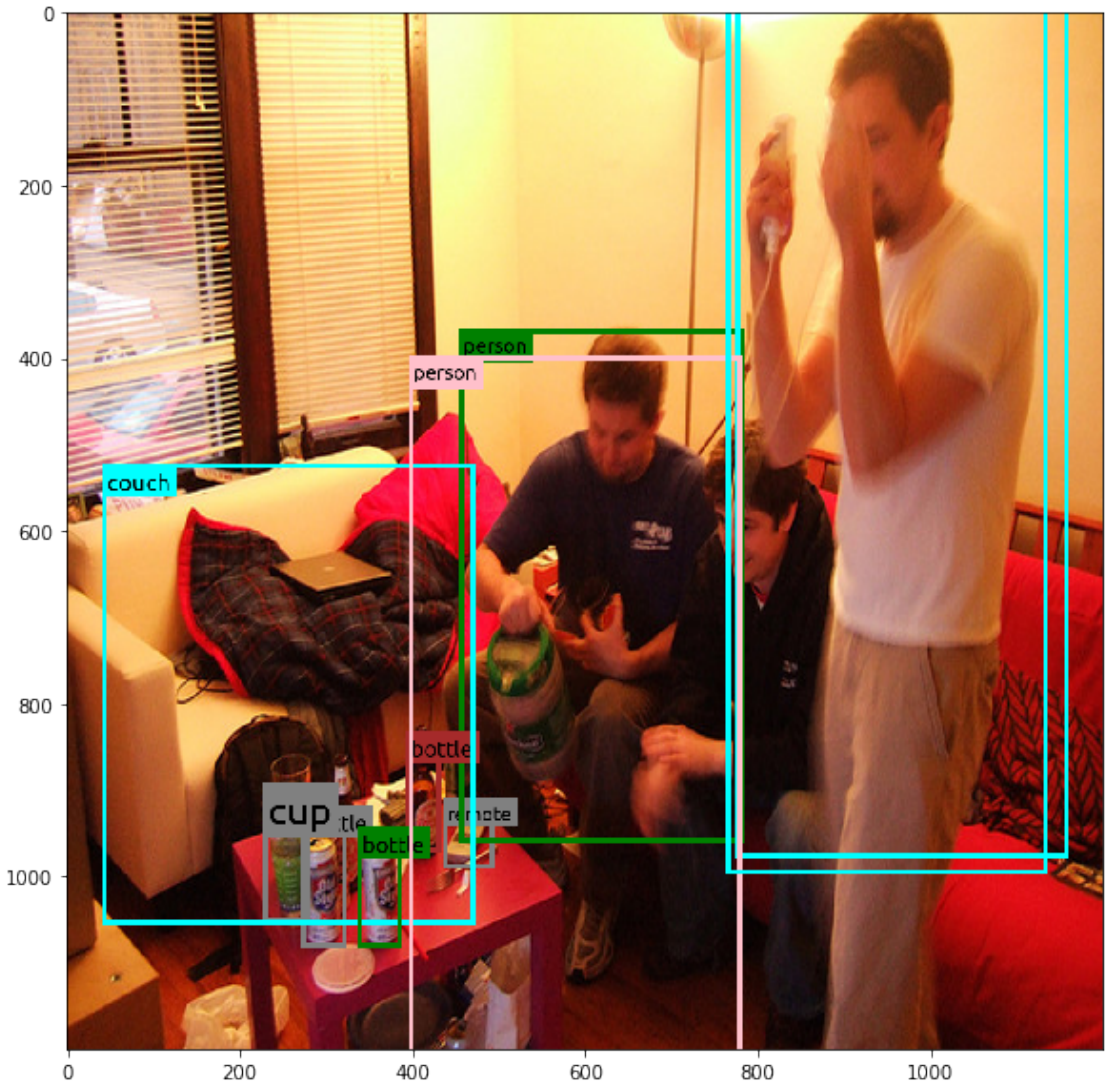
```
                                dynamic_axes={'input' : {0 : 'batch_size'},    # variable lenght ax
                                              'output' : {0 : 'batch_size'}}
                                   )
```

In [19]:
```
# inference using onnx
onnx_model = onnx.load(export_path)
onnx.checker.check_model(onnx_model)


ort_session = onnxruntime.InferenceSession(export_path)

# compute ONNX Runtime output prediction
ort_inputs = {ort_session.get_inputs()[0].name: to_numpy(sample_input)}
ort_outs = ort_session.run(None, ort_inputs)

torch_out = model(sample_input)
```

0.9 Inference using ONNX

In [20]:
```
locs,confs,*_= ort_outs
locs = torch.Tensor(locs)
confs = torch.Tensor(confs)

boxes, labels, scores = encoder.decode_batch(locs,confs,criteria=0.05, max_output=5)
boxes = boxes[0]
labels = labels[0]

for box,label in zip(boxes,labels):
    box = box.cpu().detach().numpy()
    label = label_dict[label.item()]
    draw_bounding_box_on_image(input_image, box, label)

fig = plt.gcf()
fig.set_size_inches(10, 10)
plt.imshow(input_image)
```

Out[20]:
```
<matplotlib.image.AxesImage at 0x7efdbc65e630>
```



0.10 SSD-MobileNets-v1 (300x300)

```
In [21]: from object_detection_utils import draw_bounding_box_on_image
         models_src_path= "./pytorch-ssd"
         sys.path.insert(0,models_src_path)
         from vision.ssd.mobilenetv1_ssd import create_mobilenetv1_ssd, create_mobilenetv1_ssd_

         from vision.utils import box_utils

In [22]: def preprocess_image_to_batch(input_image,img_size):
             preprocess = transforms.Compose([
                 transforms.Resize(img_size),
                 transforms.ToTensor(),
                 transforms.Normalize(mean=[0.485, 0.456, 0.406], std=[0.229, 0.224, 0.225]),
```

```
        ])
        input_tensor = preprocess(input_image)
        input_batch = input_tensor.unsqueeze(0)
        return input_batch
    def predict(scores,boxes,height=300,width=300, top_k=-1,nms_method=None,
                prob_threshold=0.09,iou_threshold=0.5,sigma=0.01,candidate_size=200):
        """
        input transformed image
        """
        cpu_device = torch.device("cpu")
        boxes = boxes[0]
        scores = scores[0]

        # this version of nms is slower on GPU, so we move data to CPU.
        boxes = boxes.to(cpu_device)
        scores = scores.to(cpu_device)
        picked_box_probs = []
        picked_labels = []
        for class_index in range(1, scores.size(1)):
            probs = scores[:, class_index]
            mask = probs > prob_threshold
            probs = probs[mask]
            if probs.size(0) == 0:
                continue
            subset_boxes = boxes[mask, :]
            box_probs = torch.cat([subset_boxes, probs.reshape(-1, 1)], dim=1)
            box_probs = box_utils.nms(box_probs, nms_method,
                                      score_threshold=prob_threshold,
                                      iou_threshold=iou_threshold,
                                      sigma=sigma,
                                      top_k=top_k,
                                      candidate_size=candidate_size)
            picked_box_probs.append(box_probs)
            picked_labels.extend([class_index] * box_probs.size(0))
        if not picked_box_probs:
            return torch.tensor([]), torch.tensor([]), torch.tensor([])
        picked_box_probs = torch.cat(picked_box_probs)
        picked_box_probs[:, 0] *= width
        picked_box_probs[:, 1] *= height
        picked_box_probs[:, 2] *= width
        picked_box_probs[:, 3] *= height
        return picked_box_probs[:, :4], torch.tensor(picked_labels), picked_box_probs[:, 4
```

In [ ]:

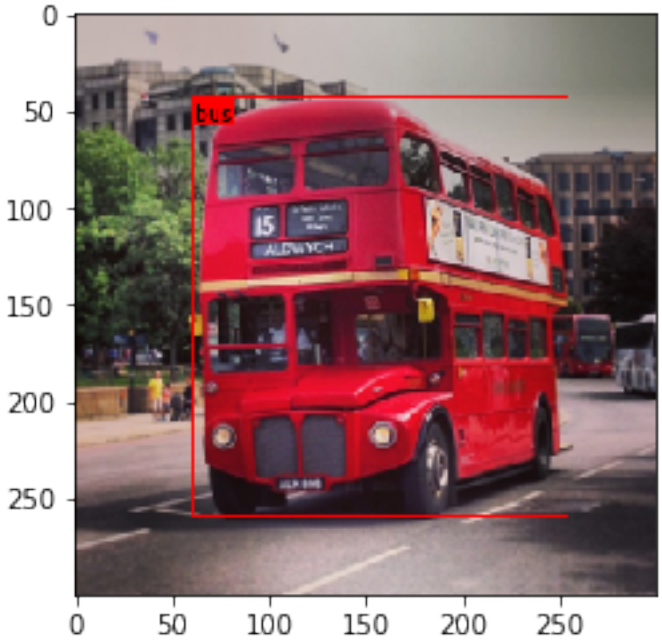
In [23]:
```
label_path="./voc-model-labels.txt"
class_names = [name.strip() for name in open(label_path).readlines()]
num_classes = len(class_names)
```

```
model = create_mobilenetv1_ssd(num_classes, is_test=True,device="cpu")
model.load("./pretrained_models/mobilenet-v1-ssd-mp-0_675.pth")
model.eval()

filename = "000000001584.jpg"
input_image = Image.open(filename)
img_size= [300,300]
input_image = input_image.resize(img_size)
input_batch = preprocess_image_to_batch(input_image,img_size)

with torch.no_grad():
    out_scores,out_boxes= model(input_batch)

boxes,labels,probs=predict(out_scores,out_boxes)
labels = list(map(lambda x:label_dict[x.item()],labels))
```

0.11 Inference using Torch

```
In [24]: for box,label in zip(boxes,labels):
             box = box.cpu().detach().numpy()
             draw_bounding_box_on_image(input_image, box, label,scale=False)
         plt.imshow(input_image)
```

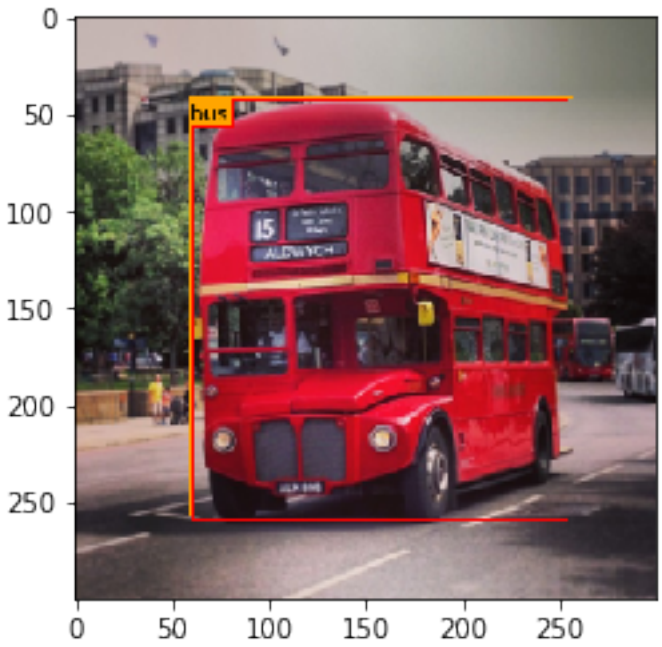
```
Out[24]: <matplotlib.image.AxesImage at 0x7efe288bcb38>
```



```
In [25]: sample_input = preprocess_image_to_batch(input_image,img_size)
         export_path = "./exported_models/ssd_mobilenetv1_300.onnx"

         if EXPORT:
             torch.onnx.export(
                           model,
                           sample_input,
                           export_path,
                           export_params=True,
                           opset_version=10,          # the ONNX version to export the model t
                           do_constant_folding=True,  # whether to execute constant folding fo
                           input_names = ['input'],   # the model's input names
                           output_names = ['output'], # the model's output names
                           dynamic_axes={'input' : {0 : 'batch_size'},    # variable lenght ax
                                         'output' : {0 : 'batch_size'}}
                              )

In [26]: # inference using onnx
         onnx_model = onnx.load(export_path)
         onnx.checker.check_model(onnx_model)


         ort_session = onnxruntime.InferenceSession(export_path)

         # compute ONNX Runtime output prediction
         ort_inputs = {ort_session.get_inputs()[0].name: to_numpy(sample_input)}
         ort_outs = ort_session.run(None, ort_inputs)
```

0.12 Inference using ONNX

```
In [27]: out_scores,out_boxes= ort_outs
         out_scores=torch.Tensor(out_scores)
         out_boxes=torch.Tensor(out_boxes)

         boxes,labels,probs=predict(out_scores,out_boxes)
         labels = list(map(lambda x:label_dict[x.item()],labels))

         for box,label in zip(boxes,labels):
             draw_bounding_box_on_image(input_image, box, label,scale=False)
         plt.imshow(input_image)

Out[27]: <matplotlib.image.AxesImage at 0x7efcff98cac8>
```



0.13 GNMT WMT16

```
In [28]: %load_ext autoreload
         %autoreload 2

The autoreload extension is already loaded. To reload it, use:
  %reload_ext autoreload
```

```
In [29]: models_src_path= "./training/rnn_translator/pytorch/" #path to seq2seq
         sys.path.insert(0,models_src_path)

         from seq2seq import models
         from seq2seq.inference.inference import Translator
         import seq2seq.data.config as config
         from seq2seq.data import tokenizer
         from ast import literal_eval
         from seq2seq.models.gnmt import GNMT
         from seq2seq.data.dataset import ParallelDataset
         from seq2seq.inference.beam_search import SequenceGenerator
```

```
In [30]: ckpt_path="./pretrained_models/gnmt.pth"
         setattr(tokenizer,'default',lambda :int(config.UNK))
         checkpoint = torch.load(ckpt_path, map_location={'cuda:0': 'cpu'})

         vocab_size = checkpoint['tokenizer'].vocab_size
```

```
model_config = dict(vocab_size=vocab_size,
                    **literal_eval(checkpoint['config'].model_config))
model_config['batch_first'] = True
model = GNMT(**model_config)
state_dict = checkpoint['state_dict']
model.load_state_dict(state_dict)

if torch.cuda.is_available() and CUDA :
    model.to('cuda')

model.eval()

tokenizer = checkpoint['tokenizer']
args = {
        "beam_size":5,
       "max_seq_len":80,
       "len_norm_factor":0.6,
       "len_norm_const":5.0,
       "cov_penalty_factor":0.1,
       "cuda":(torch.cuda.is_available() and CUDA),
        "batch_size":128,
        "batch_first":True
       }
config.TGT_TEST_FNAME = "newstest2014.tok.bpe.32000.de"
dataset_dir = "./"

test_data = ParallelDataset(
        src_fname=os.path.join(dataset_dir, config.SRC_TEST_FNAME),
        tgt_fname=os.path.join(dataset_dir, config.TGT_TEST_FNAME),
        tokenizer=tokenizer,
        min_len=0,
        max_len=150,
        sort=False)

test_loader = test_data.get_loader(batch_size=args["batch_size"],
                                   batch_first=args["batch_first"],
                                   shuffle=False,
                                   num_workers=0)

translator = Translator(model,
                        tokenizer,
                        loader=test_loader,
                        beam_size=args["beam_size"],
                        max_seq_len=args["max_seq_len"],
                        len_norm_factor=args["len_norm_factor"],
                        len_norm_const=args["len_norm_const"],
                        cov_penalty_factor=args["cov_penalty_factor"],
                        cuda=args["cuda"])
```

```
        output = []
        input_corpus = []
        loader = test_loader
        beam_size = args["beam_size"]
        batch_size = args["batch_size"]
        batch_first = args["batch_first"]
        cuda = args["cuda"]
        generator = SequenceGenerator(
                    model=model,
                    beam_size=beam_size,
                    cuda=cuda,
                )
```

```
:::MLPv0.5.0 gnmt 1581704833.602252483 (./training/rnn_translator/pytorch/seq2seq/models/gnmt.p
:::MLPv0.5.0 gnmt 1581704833.611447334 (./training/rnn_translator/pytorch/seq2seq/models/gnmt.p
:::MLPv0.5.0 gnmt 1581704833.622555017 (./training/rnn_translator/pytorch/seq2seq/models/gnmt.p
:::MLPv0.5.0 gnmt 1581704836.053183794 (./training/rnn_translator/pytorch/seq2seq/data/sampler
```

```
DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.053183794 (./training/rnn_translator/pyto
```

```
:::MLPv0.5.0 gnmt 1581704836.063802719 (./training/rnn_translator/pytorch/seq2seq/inference/bea
```

```
DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.063802719 (./training/rnn_translator/pyto
```

```
:::MLPv0.5.0 gnmt 1581704836.075959921 (./training/rnn_translator/pytorch/seq2seq/inference/bea
```

```
DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.075959921 (./training/rnn_translator/pyto
```

```
:::MLPv0.5.0 gnmt 1581704836.087132931 (./training/rnn_translator/pytorch/seq2seq/inference/bea
```

```
DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.087132931 (./training/rnn_translator/pyto
```

```
:::MLPv0.5.0 gnmt 1581704836.097472668 (./training/rnn_translator/pytorch/seq2seq/inference/bea
```

```
DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.097472668 (./training/rnn_translator/pyto
```

```
:::MLPv0.5.0 gnmt 1581704836.108817339 (./training/rnn_translator/pytorch/seq2seq/inference/bea
```

```
DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.108817339 (./training/rnn_translator/pyto

:::MLPv0.5.0 gnmt 1581704836.119456053 (./training/rnn_translator/pytorch/seq2seq/inference/bea

DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.119456053 (./training/rnn_translator/pyto

:::MLPv0.5.0 gnmt 1581704836.128023624 (./training/rnn_translator/pytorch/seq2seq/inference/bea

DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.128023624 (./training/rnn_translator/pyto

:::MLPv0.5.0 gnmt 1581704836.138738871 (./training/rnn_translator/pytorch/seq2seq/inference/bea

DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.138738871 (./training/rnn_translator/pyto

:::MLPv0.5.0 gnmt 1581704836.152134418 (./training/rnn_translator/pytorch/seq2seq/inference/bea

DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.152134418 (./training/rnn_translator/pyto

:::MLPv0.5.0 gnmt 1581704836.162775993 (./training/rnn_translator/pytorch/seq2seq/inference/bea

DEBUG:mlperf_compliance::::MLPv0.5.0 gnmt 1581704836.162775993 (./training/rnn_translator/pyto
```

In [31]:
```
src_compare =[]
tgt_compare =[]
sample_input = None
for i, (src, tgt) in enumerate(test_loader):
    src, src_length = src
    tgt,tgt_length = tgt
    for i in range(len(src)):
        src_compare.append(src[i].tolist())
        tgt_compare.append(tgt[i].tolist())
    if translator.batch_first:
        batch_size = src.size(0)
    else:
        batch_size = src.size(1)

    bos = [config.BOS] * (batch_size * beam_size)
    bos = torch.LongTensor(bos)
    if translator.batch_first:
```

```
            bos = bos.view(-1, 1)
        else:
            bos = bos.view(1, -1)

        src_length = torch.LongTensor(src_length)

        if cuda:
            src = src.cuda()
            src_length = src_length.cuda()
            bos = bos.cuda()

        with torch.no_grad():
            context = translator.model.encode(src, src_length)
            context = [context, src_length, None]
            if sample_input is None:
                sample_input = (src,src_length,src_length)
            if beam_size == 1:
                generator = translator.generator.greedy_search
            else:
                print("Using beam search")
                generator = translator.generator.beam_search
            preds, lengths, counter = generator(batch_size, bos, context)


        preds = preds.cpu()
        lengths = lengths.cpu()

        output = []
        for idx, pred in enumerate(preds):
            end = lengths[idx] - 1
            pred = pred[1: end]
            pred = pred.tolist()
            out = translator.tokenizer.detokenize(pred)
            output.append(out)
        break
```

```
Using beam search
```

In [32]:
```
# for proper output on exporting as pdf
def pprint(s,n_in_line=10):
    s=s.split()
    print("\t",end="")
    for i,word in enumerate(s,1):
        if i%n_in_line==0:
            print()
        else:
            print(word,end=" ")
    print("\n")
```

0.14 Inference using Torch

In [33]:
```
src_compare = [translator.tokenizer.detokenize(x) for x in src_compare]
tgt_compare = [translator.tokenizer.detokenize(x) for x in tgt_compare]

print("Input corpus:")
pprint(src_compare[0])
print("Ground truth :")
pprint(tgt_compare[0])
print("Prediction :")
pprint(output[0])
```

```
Input corpus:
        According to Arnold , every possible test was carried
prior to the selection of the location for the
light posts : &quot; Using a goods vehicle loaded
particularly long tree trunks , we also tested whether
vehicles could access the B 33 from the Sul<unk>
without knocking over the traffic light posts &quot; .

Ground truth :
        Es wurde laut Arnold bei der Standortwahl der Ampelmasten
alles ausgetestet : &quot; Mittels eines extra für uns
besonders langen Holzstämmen beladener Transporter haben wir <unk> estet
ob diese Fahrzeuge aus dem Sul<unk> achweg auf die
33 ausfahren können , ohne den Ampelmasten umzuknicken &quot;


Prediction :
        Laut Arnold war jeder mögliche Test vor der Auswahl
Standortes für die Ampeln ausgeführt : &quot; Mit einem
, das mit besonders langen Baumwollsteinen geladen wurde ,
wir auch untersucht , ob solche Fahrzeuge die B
vom Sulve-Bahnhof überqueren konnten .
```

In [ ]: