Pytorch Computer Vision Cookbook

2021210088 허지혜

Chapter4. Single-Object Detection

1. Deploy Model

- torchvision 버전 확인

```
import torchvision
torchvision.__version__
```

0.10.0+cu111

- 필요한 함수 정의

scale_label, rescale_label, resize, transformer 등등

```
import os
import pandas as pd
import matplotlib.pylab as plt
import torch
%matplotlib inline

def scale_label(a,b):
    div = [ai/bi for ai,bi in zip(a,b)]
    return div

def rescale_label(a,b):
    div = [ai*bi for ai,bi in zip(a,b)]
    return div

import torchvision.transforms.functional as TF

def resize_img_label(image,label=(0.,0.),target_size=(256,256)):
    w_orig,h_orig = image.size
    w_target,h_target = target_size
    cx, cy= label

    # resize image and label
    image_new = TF.resize(image,target_size)
    label_new= cx/w_orig*w_target, cy/h_orig*h_target
```

```
    return image_new,label_new
```

```
def transformer(image, label, params):
    image,label=resize_img_label(image,label,params["target_size"])

    if params["scale_label"]:
        label=scale_label(label,params["target_size"])

    image=TF.to_tensor(image)
    return image, label
```

- AMD dataset

```
from torch.utils.data import Dataset
from PIL import Image

class AMD_dataset(Dataset):
    def __init__(self, path2data, transform, trans_params):
        pass

    def __len__(self):
        # return size of dataset
        return len(self.labels)

    def __getitem__(self, idx):
        pass
```

- init 함수 정의

```
def __init__(self, path2data, transform, trans_params):

    # full path of the labels file
    path2labels=os.path.join(path2data,"Training400_labels","Fovea_location.xlsx")

    # read labels as a data frame
    labels_df=pd.read_excel(path2labels,index_col="ID")

    # extract labels
    self.labels = labels_df[["Fovea_X","Fovea_Y"]].values

    # extract ID and imgName columns
    self.imgName=labels_df["imgName"]
```

```
    self.ids=labels_df.index

    self.fullPath2img=[0]*len(self.ids)
    for id_ in self.ids:
        if self.imgName[id_][0]=="A":
            prefix="AMD"
        else:
            prefix="Non-AMD"


self.fullPath2img[id_-1]=os.path.join(path2data,"Training400",prefix,self.imgName[id
_])

    self.transform = transform
    self.trans_params=trans_params
```

- getitem 함수 정의

```
def __getitem__(self, idx):
    # load PIL image
    image = Image.open(self.fullPath2img[idx])
    label= self.labels[idx]

    # transform to tensor
    image,label = self.transform(image,label,self.trans_params)

    return image, label
```

- 함수 재정의

```
AMD_dataset.__init__=__init__
AMD_dataset.__getitem__=__getitem__
```

- parameter

```
path2data="./data/"

trans_params_val={
    "target_size" : (256, 256),
    "p_hflip" : 0.0,
    "p_vflip" : 0.0,
    "p_shift" : 0.0,
```

```
    "p_brightness": 0.0,
    "p_contrast": 0.0,
    "p_gamma": 0.0,
    "gamma": 0.0,
    "scale_label": True,
}
amd_ds2=AMD_dataset(path2data,transformer,trans_params_val)
```

- train, val 데이터 나누기

```
from sklearn.model_selection import ShuffleSplit

sss = ShuffleSplit(n_splits=1, test_size=0.2, random_state=0)

indices=range(len(amd_ds2))

for train_index, val_index in sss.split(indices):
    print(len(train_index))
    print("-"*10)
    print(len(val_index))
```

```
320
----------
80
```

```
from torch.utils.data import Subset
val_ds=Subset(amd_ds2,val_index)
print(len(val_ds))
```

```
80
```

- Data Loaders

```
from torch.utils.data import DataLoader
val_dl = DataLoader(val_ds, batch_size=16, shuffle=False)
```

- 모형 정의

```
import torch.nn as nn
import torch.nn.functional as F
```

```
class Net(nn.Module):
    def __init__(self, params):
```

```
        super(Net, self).__init__()

    def forward(self, x):
        return x
```

```
def __init__(self, params):
    super(Net, self).__init__()
    C_in,H_in,W_in=params["input_shape"]
    init_f=params["initial_filters"]
    num_outputs=params["num_outputs"]
    self.conv1 = nn.Conv2d(C_in, init_f, kernel_size=3,stride=2,padding=1)
    self.conv2 = nn.Conv2d(init_f+C_in, 2*init_f, kernel_size=3,stride=1,padding=1)
    self.conv3 = nn.Conv2d(3*init_f+C_in, 4*init_f, kernel_size=3,padding=1)
    self.conv4 = nn.Conv2d(7*init_f+C_in, 8*init_f, kernel_size=3,padding=1)
    self.conv5 = nn.Conv2d(15*init_f+C_in, 16*init_f, kernel_size=3,padding=1)
    self.fc1 = nn.Linear(16*init_f, num_outputs)
def forward(self, x):
    identity=F.avg_pool2d(x,4,4)
    x = F.relu(self.conv1(x))
    x = F.max_pool2d(x, 2, 2)
    x = torch.cat((x, identity), dim=1)

    identity=F.avg_pool2d(x,2,2)
    x = F.relu(self.conv2(x))
    x = F.max_pool2d(x, 2, 2)
    x = torch.cat((x, identity), dim=1)

    identity=F.avg_pool2d(x,2,2)
    x = F.relu(self.conv3(x))
    x = F.max_pool2d(x, 2, 2)
    x = torch.cat((x, identity), dim=1)

    identity=F.avg_pool2d(x,2,2)
    x = F.relu(self.conv4(x))
    x = F.max_pool2d(x, 2, 2)
    x = torch.cat((x, identity), dim=1)

    x = F.relu(self.conv5(x))

    x=F.adaptive_avg_pool2d(x,1)
    x = x.reshape(x.size(0), -1)
```

```
    x = self.fc1(x)
    return x
```

```
Net.__init__=__init__
Net.forward=forward
```

- 모형 확인

```
params_model={
          "input_shape": (3,256,256),
          "initial_filters": 16,
          "num_outputs": 2,
              }
# create model
model = Net(params_model)
model.eval()
```

```
Net(
  (conv1): Conv2d(3, 16, kernel_size=(3, 3), stride=(2, 2), p
adding=(1, 1))
  (conv2): Conv2d(19, 32, kernel_size=(3, 3), stride=(1, 1),
padding=(1, 1))
  (conv3): Conv2d(51, 64, kernel_size=(3, 3), stride=(1, 1),
padding=(1, 1))
  (conv4): Conv2d(115, 128, kernel_size=(3, 3), stride=(1,
1), padding=(1, 1))
  (conv5): Conv2d(243, 256, kernel_size=(3, 3), stride=(1,
1), padding=(1, 1))
  (fc1): Linear(in_features=256, out_features=2, bias=True)
)
```

- device 정의

```
# move model to cuda/gpu device
if torch.cuda.is_available():
    device = torch.device("cuda")
    model=model.to(device)
```

2. Deployment

```
path2weights="./models/weights.pt"
```

```
model.load_state_dict(torch.load(path2weights))
```

- loss_epoch 정의

```
# define device as a global variable
device = torch.device("cuda")

def loss_epoch(model,loss_func,dataset_dl,sanity_check=False,opt=None):
    running_loss=0.0
    running_metric=0.0
    len_data=len(dataset_dl.dataset)

    for xb, yb in dataset_dl:
        # convert to tensor
        yb=torch.stack(yb,1)
        yb=yb.type(torch.float32).to(device)

        # get model output
        output=model(xb.to(device))

        # get loss per batch
        loss_b,metric_b=loss_batch(loss_func, output, yb, opt)

        # update running loss
        running_loss+=loss_b

        # update running metric
        if metric_b is not None:
            running_metric+=metric_b

        # break the loop for sanity check
        if sanity_check is True:
            break

    # average loss value
    loss=running_loss/float(len_data)

    # average metric value
    metric=running_metric/float(len_data)

    return loss, metric
```

- cxcy2bbox 정의

```
def cxcy2bbox(cxcy,w=50./256,h=50./256):
    # define two new tensors for w and h
    w_tensor=torch.ones(cxcy.shape[0],1,device=cxcy.device)*w
    h_tensor=torch.ones(cxcy.shape[0],1,device=cxcy.device)*h

    # extract cx and cy
    cx=cxcy[:,0].unsqueeze(1)
    cy=cxcy[:,1].unsqueeze(1)

    # concat cx,cy,w and h
    boxes=torch.cat((cx,cy, w_tensor, h_tensor), -1)  # cx,cy,w,h

    return torch.cat((boxes[:, :2] - boxes[:, 2:]/2,      # xmin, ymin
                      boxes[:, :2] + boxes[:, 2:]/2), 1)  # xmax, ymax
```

- metrics_batch 정의

```
def metrics_batch(output, target):
    output=cxcy2bbox(output)
    target=cxcy2bbox(target)

    iou=torchvision.ops.box_iou(output, target)
    return torch.diagonal(iou, 0).sum().item()
```

- loss_batch 정의

```
def loss_batch(loss_func, output, target, opt=None):

    # get loss
    loss = loss_func(output, target)

    # get performance metric
    metric_b = metrics_batch(output,target)

    if opt is not None:
        opt.zero_grad()
        loss.backward()
        opt.step()

    return loss.item(), metric_b
```

3. Verify(확인하다)

```
loss_func=nn.SmoothL1Loss(reduction="sum")

with torch.no_grad():
    loss,metric=loss_epoch(model,loss_func,val_dl)
print(loss,metric)
```

0.014950922783464193 0.3721194565296173

- 시각화

```
from PIL import ImageDraw
import numpy as np
import torchvision.transforms.functional as tv_F
np.random.seed(0)

import matplotlib.pylab as plt
%matplotlib inline
```

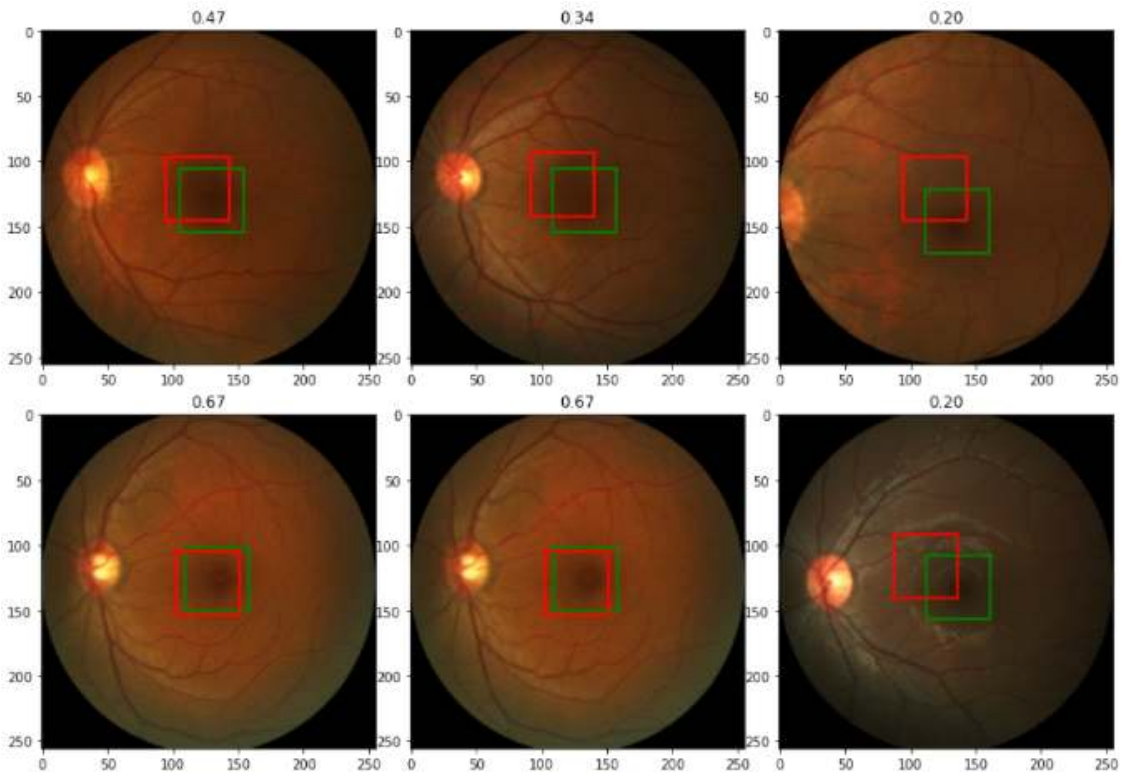
- tensor to array

```
def show_tensor_2labels(img,label1,label2,w_h=(50,50)):
    label1=rescale_label(label1,img.shape[1:])
    label2=rescale_label(label2,img.shape[1:])
    img=tv_F.to_pil_image(img)

    w,h=w_h
    cx,cy=label1
    draw = ImageDraw.Draw(img)
    draw.rectangle(((cx-w/2, cy-h/2), (cx+w/2, cy+h/2)),outline="green",width=2)

    cx,cy=label2
    draw.rectangle(((cx-w/2, cy-h/2), (cx+w/2, cy+h/2)),outline="red",width=2)

    plt.imshow(np.asarray(img))
```

```
# get random samples
rndInds=np.random.randint(len(val_ds),size=10)
print(rndInds)
```

[44 47 64 67 67 9 21 36 70 12]

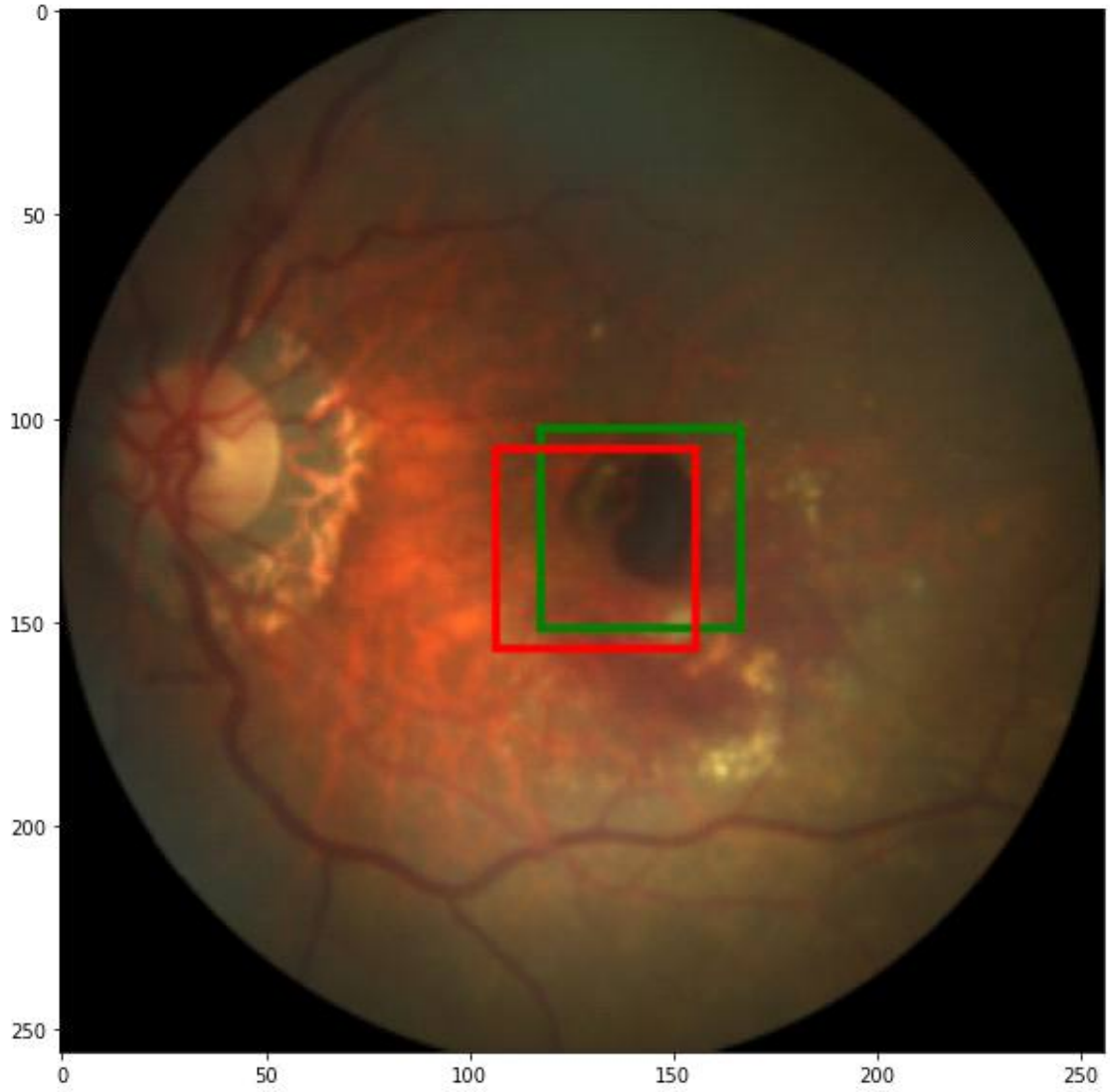
```
plt.rcParams['figure.figsize'] = (15, 10)
plt.subplots_adjust(wspace=0.0, hspace=0.15)

for i,rndi in enumerate(rndInds):
    img,label=val_ds[rndi]
    h,w=img.shape[1:]
    with torch.no_grad():
        label_pred=model(img.unsqueeze(0).to(device))[0].cpu()

    plt.subplot(2,3,i+1)
    show_tensor_2labels(img,label,label_pred)

    # calculate IOU
    label_bb=cxcy2bbox(torch.tensor(label).unsqueeze(0))
    label_pred_bb=cxcy2bbox(label_pred.unsqueeze(0))
    iou=torchvision.ops.box_iou(label_bb, label_pred_bb)
    plt.title("%.2f" %iou.item())

    if i>4:
        break
```



```
def load_img_label(labels_df,id_):
    imgName=labels_df["imgName"]
    if imgName[id_][0]=="A":
        prefix="AMD"
    else:
        prefix="Non-AMD"

    fullPath2img=os.path.join(path2data,"Training400",prefix,imgName[id_])
    img = Image.open(fullPath2img)

    # centroid
    x=labels_df["Fovea_X"][id_]
    y=labels_df["Fovea_Y"][id_]

    label=(x,y)
    return img,label
```

```
path2labels=os.path.join(path2data,"Training400","Fovea_location.xlsx")
labels_df=pd.read_excel(path2labels,index_col="ID")

img,label=load_img_label(labels_df,1)
print(img.size, label)

img,label=resize_img_label(img,label,target_size=(256,256))
print(img.size, label)

img=TF.to_tensor(img)
label=scale_label(label,(256,256))
print(img.shape)

with torch.no_grad():
    label_pred=model(img.unsqueeze(0).to(device))[0].cpu()

show_tensor_2labels(img,label,label_pred)
```

```
(2124, 2056) (1182.26427759023, 1022.01884158854)
(256, 256) (142.4951295024006, 127.25526432230848)
torch.Size([3, 256, 256])
```




```
import time
elapsed_times=[]
with torch.no_grad():
    for k in range(100):
        start=time.time()
        label_pred=model(img.unsqueeze(0).to(device))[0].cpu()
        elapsed=time.time()-start
        elapsed_times.append(elapsed)
print("inference time per image: %.4f s" %np.mean(elapsed_times))
```

inference time per image: 0.0013 s